

Division of Aquatic and Wildlife Resources

Guam Department of Agriculture



Annual Report Fiscal Year 1992

ANNUAL REPORT FISCAL YEAR 1992

DIVISION OF AQUATIC AND WILDLIFE RESOURCES

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October 1, 1991 to September 30, 1992

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TABLE OF CONTENTS

FY 1992

		Page
Section 1	Coordination and Administration – Project FW-2R-29 (Federal Aid in Sport Fish and Wildlife Restoration Acts)	
Job C-1	Coordination of Guam's Fish and Wildlife Programs	1
Job C-2	Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources	6
Job C-3	Public Information and Education of Guam's Fish and Wildlife Restoration and Endangered Species Programs	13
Section II	Guam Fisheries Investigations – Project FW-2R-29 (Federal Aid in Sport Fish Restoration Act)	
Job F-1-1-1	Offshore Fisheries Survey	17
	Guam International Fishing Derby (Appendix 1)	25
Job F-1-1-2	Inshore Fisheries Survey	27
	Inshore Aerial Survey (Appendix 1)	39
Job F-1-2-1	Fisheries Data Processing	43
Job F-1-3-2	Biology of <i>Mulloides flavolineatus</i>	45
Job F-1-3-3	Biology of <i>Lethrinus harak</i>	46
Job F-1-4-1	Establishment of a Marine Conservation Area	49
Job F-2-1-1	Fisheries Studies in Fena Lake	50
Job F-2-1-2	Biological Survey of the Ugum River	51
Section III	Guam Fisheries Development – Project F-2-D (Federal Aid in Sport Fish Restoration Act)	
Job F-2-D-6	Marine Fish Habitat Improvement and Aggregating Devices	52
Job F-2-D-7	Construction of Boating Access Facilities	56
Job F-2-D-9	Development of Inshore Fishing Access Facilities	57
Non-Federally Funded Projects		
	Giant Clam Transplantation	59
	Sea Turtle Monitoring Annual Report	62
	Guam Commercial Fisheries	65

Section IV Guam Wildlife Investigation Project FW-2R-29
(Federal Aid in Wildlife Restoration Act)

Job W-1-1-1	Determination of Current Population Size and Distribution of Guam Deer	67
Job W-1-2-2	Population Size and Distribution of Wild Pigs on Guam	72
Job W-2-1-2	Population Numbers and Distribution of Philippine Turtle Doves	75
Job W-2-2-1	Preparation of a Status Report and a Species Management Plan for the Black Francolin	78
Job W-2-2-2	Population Size and Distribution of Black Francolin on Guam	79
Job W-3-1-1	The Status and Ecology of Wild Asiatic Water Buffalo on Guam	82
Job W-4-1-1	Survey and Inventory of Non-Game Birds	84
	Damage to Wildlife and Other Natural Resources by Typhoon Yuri (Appendix A)	93
	Assessment of Damage to Guam's Natural Resources from Typhoon Omar	95
Job W-5-1-2	Natural History, Biology, and Habitat Protection for Marianas Fruit Bats	99
Job W-5-1-4	Roost Site Characteristics of Marianas Fruit Bats	106

Section V Guam Endangered Species Investigation Project E-1-7
(Section 6 – Endangered Species Act of 1973)

Job 4-1	Captive Breeding Endangered Native Birds	107
Job 4-2	Development of an Experimental Population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands	111
Job 7-1	Biology of the Brown Tree Snake	114
Job 7-3	Development and Testing of Control Methods for the Brown Tree Snake	115

JOB PROGRESS REPORT COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29
SUB-PROJECT NO.: C-1
JOB NO.: 1

JOB TITLE: Coordination of Guam's Fish and Wildlife Programs

PERIOD COVERED: October 1, 1991 to September 30, 1992

OBJECTIVES

To plan, coordinate, supervise, and administer all fish and wildlife restoration and endangered species programs.

PROCEDURES

1. Supervise the planning and documentation of the Fish and Wildlife programs.
2. Administer all fiscal and budgetary matters and coordinate with the Central Accounting and Budget Office.
3. Administer all personnel matters including recruitment of off-island staff.
4. Represent the Division and Department of Agriculture in all matters pertaining to Fish and Wildlife Resources.

RESULTS

There were several staff changes within the Division during the year:

Administration: The Administrative Assistant position was vacated in May. Due to increases in projects and personnel, the Division felt its needs would be better served if an Administrative Officer, a level higher than an Administrative Assistant, were recruited. Applicants from an old list compiled by Personnel were interviewed however, the Committee was not satisfied with the field of candidates. Thus, a selection was not made. An updated list of qualified applicants has been requested from Personnel and recruitment is expected in early FY '93. Also, the positions of Word Processing Supervisor and a second Public Information Officer remained unfilled due to a lack of funding. These locally-funded positions were approved this fiscal year however, funding was not provided. The Division has been assured however, that such positions will be funded in the new fiscal year. The Biologist II position for the locally-funded Technical Assistance Program has been announced and recruitment is expected during the new fiscal year.

Wildlife: The Wildlife Biologist III (Herpetologist) position, vacated in February, has not been filled, although the vacancy has already been announced. The same holds true for a second Wildlife Biologist II position, funded in 1991 with OTIA money to work on brown tree snake control. Recruitment efforts are also ongoing for a game biologist (Wildlife Biologist III), a vacancy created by the transfer of the incumbent to the Endangered Species

Endangered Species program. The Division also lost a Wildlife Technician I assigned to the Brown Tree Snake project and a Wildlife Biological Aide.

Fisheries: Three Fisheries Biologist III and a Fisheries Technician I resigned during the year to either pursue higher education off-island, or a career in the private sector. One of the Fisheries Biologist III positions has been filled; announcements of the other vacancies are continuing.

Law Enforcement: This Section experienced an unprecedented growth in terms of staff recruitment. A total of 10 new Conservation Officers I joined the staff during this reporting period. The Law Enforcement Supervisor (Conservation Officer III) position, which was vacated in March due to retirement, was filled in September. Vacancies yet to be filled include a Conservation Officer II, created by the promotion of the incumbent to Conservation Officer III, and two new Conservation Officer I positions.

A significant problem for recruitment of new staff was created when the Government of Guam implemented the "Hay Study," a government-wide salary reclassification plan commissioned by the Civil Service Commission. The implementation of this plan resulted in the significant reduction in entry level (Step 1) salaries nearly across-the-board throughout the Government of Guam; professional positions were hit particularly hard. Although no incumbent staff suffered any reduction of salary, the greatly reduced entry level salaries has created a difficult situation with regard to the filling of professional level vacancies.

All told, the Division had the following vacant positions at the end of the reporting period:

Administrative Officer - new position, in lieu of an Administrative Assistant
Public Information Officer - new position, locally funded
Word Processing Supervisor - new position, locally funded
Wildlife Biologist III (Game Management)
Wildlife Biologist III (Aviculture) - new position
Wildlife Biologist III (Wetlands) - new position, Special Funding
Wildlife Biologist III (Herpetologist)
Wildlife Biologist II (Herpetologist) - funded by source of funding needed
Wildlife Biologist I (Crow Recovery), new position
Wildlife Biologist I (Crow Recovery), new position
Fisheries Biologist III (Non-fish), locally funded
Fisheries Biologist III (Freshwater)
Fisheries Biologist III (Data Processing) - funded by U.S. Department of Commerce
Fisheries Biologist III
Fisheries Biologist II
Fisheries Biologist I - new position
Biologist II (Technical Assistance Program) - locally funded
Wildlife Biological Aide
Conservation Officer II (vacancy created by promotion of incumbent) - locally funded
Conservation Officer I - new position, locally funded
Conservation Officer I - new position, locally funded

Division staff spent the first quarter preparing the annual Job Progress Reports on research and other activities conducted during FY '91 under its various federal programs and submitted them to the U.S. Fish and Wildlife Service (USFWS) Regional Office.

Staff also devoted considerable effort to preparing the Federal Aid project documentation necessary to obligate funds for the Division's various programs during FY '93. This

documentation included annual Project Agreements for the various Fish and Wildlife Investigations and Endangered Species activities that the Division conducts. At the request of the Controller, Department of Administration and the funding agency, USFWS, the Division has revised the existing DJ/PR project FW-2R by splitting it into three new projects, a change which makes for a more efficient accounting of project costs.

The existing project FW-2R has been split into: 1) Project FW-3C, Guam Fish and Wildlife Coordination, which covers the administration and coordination of the Division's federal aid programs and which will continue to be jointly funded by wildlife (PR) and sport fisheries (DJ) funds; 2) Project F-1R, Guam Sport Fish Investigations, which covers sport fish research and survey activity and which will be funded with sport fisheries (DJ) funding; and 3) Project W-1R, Guam Wildlife Investigations, which covers wildlife research and survey activity and which will be funded with wildlife (PR) funds.

The Division's coordination and administration costs are now 50% covered by a local appropriation.

A proposal for a National Coastal Wetlands grant was prepared and submitted, requesting funding in the amount of \$255,000 for habitat enhancement for the endangered Marianas Common Moorhen within the Camp Covington wetlands at the U.S. Naval Station. This grant was requested to supplement a smaller (\$20,000) grant received from the USFWS for a similar project within the same wetland area.

The DAWR Chief devoted effort to preparing various project proposals and budget requests for brown tree snake research funds.

Fiscal and budgetary activities included monthly preparation and submission of reimbursement vouchers for various Federal Aid programs, and coordination with the Government Accounting and Budget Offices to ensure fiscal integrity. Considerable effort was devoted to rectifying a serious problem with an apparent overdraft within the DJ portion of FW-2R-28, which had never been closed out. It was determined that the proper adjustment had not been made for the across-the-board \$5,440 pay raise granted in 1990, and the locally-funded appropriation to cover a significant portion of the Division's administrative costs. The proper credits were determined and the appropriate adjustments made, not only to FW-2R-28, but also to E-1-6.

Preliminary arrangements were also made to convert the Division's Federal Aid reimbursement process to electronic transfer via "Smart-Link" instead of the manual reimbursement voucher system that has been used since the beginning of our participation in the Federal Aid program.

The Division Chief and his staff represented DAWR and the Department of Agriculture in all matters relating to fish and wildlife resources. This frequently entailed meetings with other agencies of the Government of Guam, various Federal agencies, and the military.

The Division Chief served on the Department's Land Lease Approving Committee, which must review and approve all proposed leases of government land for agricultural purposes. He also serves as a member of the Territorial Land Use Commission (TLUC). In addition, the Chief also serves as the Government of Guam's representative to the Western Pacific Regional Fisheries Management Council (WESPAC). The Chief is also a member of the Area Committee for Oil Spill Response.

Division staff made a number of off-island trips related to Federal Aid programs:

Division Chief Rufo J. Lujan represented the Government of Guam at WESPAC which met four times in Honolulu during this reporting period. Mr. Lujan also represented Guam at a meeting of the South Pacific Applied Geotechnical Commission (SOPAC) held in Vanuatu. Other travel included representing Guam at the 24th Regional Technical Meeting on Fisheries held in New Caledonia.

Division Chief Rufo J. Lujan, Public Information Officer Lillian Mariano, and Deputy Director Jose A.E. Manibusan, Biologist IV Robert Beck, and Technician Herman Muna traveled to Rota in October to show a group from Kunigami Village in Okinawa the project to establish an experimental population of the endangered Guam Rail in the wild.

Division Chief Rufo J. Lujan traveled to Washington, D.C. in February to provide staff support to the Governor at a meeting with the Office of Territorial and Insular Affairs (OTIA) to allocate the FY '92 budget appropriation for brown tree snakes and to discuss FY '93 funding proposals. He made a similar trip to Honolulu in March, to meet with Hawaii and Commonwealth of the Northern Mariana Islands (CNMI) officials regarding brown tree snake issues.

Assistant Chief Robert D. Anderson traveled to Coast Guard Reserve Training Center in Yorktown, Virginia in July to participate in the planning and design of an inter-agency oil spill response exercise that was held on Guam on July 30.

Public Information Officer Lillian Mariano and Fisheries Section Supervisor Gerry Davis coordinated and participated in an Aquatic Education Workshop sponsored by the USFWS and attended by representatives of the Federal Aid Programs from Hawaii, American Samoa, and the CNMI. The conference ended with all participants making an overnight night fieldtrip to Saipan in the CNMI.

Fisheries Section Supervisor Gerry Davis attended the WESPAC Plan Monitoring Team meetings in Hawaii held in November and May. He also attended the WESPAC Council meeting held at the end of June.

Fisheries Biologist Rob Myers attended the WESPAC Plan Monitoring Team meetings in Hawaii held in February and May. He also traveled to Palau at the end of the fiscal year to participate in a "rapid ecological assessment" program co-sponsored by the Palau government and the Nature Conservancy.

Fisheries Biologist Gretchen Grimm attended a WESPAC Plan Monitoring Team meeting in Hawaii held in February.

Wildlife Technician Herman Muna traveled to Rota several times to monitor the success of the second attempt to establish an experimental population in the wild on Rota.

Wildlife Biologist Gary Wiles traveled to Rota in May to meet with CNMI forestry officials to discuss conservation of the endangered tree *Serianthes nelsonii* to participate in surveys to locate additional trees, and to gain information for use in the drafting of a Recovery Plan for that species.

Wildlife Biologist Celestino Aguon attended an Endangered Species/Pesticide workshop sponsored by the U.S. Environmental Protection Agency and held in Orlando, Florida in September.

Wildlife Section Supervisor Robert Beck and Wildlife Biologist Celestino Aguon attended a conference on the control of the brown tree snake and habu held in Okinawa in late

September. They presented a paper entitled "A Method for Protecting Nests of Marianas Crows From Brown Tree Snakes." After the conference, they presented a slide lecture on the Guam Rail captive breeding program to members of the City Council of the Kunigami Village, who are interested in conserving the Okinawa Rail.

Conservation Officers Sgt. David C. Torres and CO I Domingo C. Pangelinan attended a Covert Investigation Seminar sponsored by the USFWS and held at the Federal Law Enforcement Training Center at Glynco, Georgia in July.

The Division hosted a number of off-island visitors during the year: Robert Smith, Ernie Kosaka, Andy Yuen, John Ford, Karen Rosa, Karen Evans, Tom Fritts, Gordon Rodda, Lisa Close, Craig Clark, Earl Campbell, Bill Dusel, George Phocas, Phyllis Ha, Ray Rauch, Roger DiRosa, Jerry Leineke, Pete Nylander, and Commodore Mann, all of the USFWS, Dave Hamm, John Naughton, Fred Kyle and Joe Koczur of the National Marine Fisheries Service; and, Gary Oldenburg and Tim Ohashi of the USDA/APHIS Animal Damage Control Program.

In addition, numerous representatives of the CNMI Department of Natural Resources visited during the year to discuss subjects of mutual interest.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: C-2

JOB NO.: 1

JOB TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources

PERIOD COVERED: October 1, 1991 to September 30, 1992

BACKGROUND

The Division of Aquatic & Wildlife Resources' (DAWR) professional staff devoted a significant percentage of their time and effort to technical assistance. The rapid pace of development on the island is requiring increasing amounts of time from the Division's staff to fulfill its statutory responsibility to review and comment on development plans, rezoning applications, and various permit applications. Because of the size and complexity of some of these developments, the Division's review responsibility will require a continuing commitment that could extend even beyond project completion.

In response to the increase in work load, the Division created the Technical Assistance Program within the Administration/Coordination Section. A local appropriation has provided funding for two technical assistance staff members. In December 1990, a Biologist I was hired to work on technical assistance and a Biologist II is currently being recruited. These positions are primarily responsible for attending and commenting on projects to the Development Review Committee. In addition, a new protocol has been adopted by the Division in regards to the review of clearing and grading permit applications. Until March of 1991, clearing and grading permits were not routed to the Division for review unless pertaining to areas of sensitive environmental concern. It was the collaborative decision of the DAWR, the Guam Environmental Protection Agency (GEPA), and the Department of Public Works (permitting agency) to include the DAWR in the review process of Government of Guam permit applications. This additional duty focuses on, but not limited to, the review of permits which may impact important habitat areas.

OBJECTIVES

1. To minimize adverse environmental impact resulting from the construction of recreational, commercial, residential, industrial or public utility facilities.
2. Provide technical assistance to military and civil agencies relative to the management and protection of fish and wildlife resources.

FINDINGS

Division staff have been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Division staff members actively serve as members of the following groups:

1. Ad Hoc Fisheries Council
2. Region IX Regional Response Team - Oceania
3. Development Review Committee
4. Fish and Wildlife Conservation Committee- Andersen Air Force Base
5. Western Pacific Regional Fisheries Management Council
6. Recreational Water Use Master Plan
7. Western Pacific Regional Pelagic Plan Monitoring Team
8. Western Pacific Regional Bottomfish Plan Monitoring Team
10. Guam Aquarium Council
11. Seashore Protection Plan Task Force
12. Bird Aircraft Strike Hazard Committee - Andersen Air Force Base
13. Criminal Justice Craft Committee--Guam Community College
14. Area Committee for Oil Spills
15. Agricultural Lease Approving Committee
16. Territorial Land Use Commission
17. Land Use Plan Technical Advisory Committee
18. Pacific Regional Marine Research Board
19. South Pacific Applied Geosciences Commission
20. South Pacific Commission Regional Fisheries Program
21. International Association of Fish and Wildlife Agencies
22. Interagency Agreement Coordinating Committee on the Brown Tree Snake

Members of the Division have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Division staff maintain close liaison with the Department of Land Management, Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, University of Guam, U.S. Army Corps of Engineers (ACOE), U.S. Fish and Wildlife Service, Western Pacific Regional Fisheries Management Council, National Marine Fisheries Service, U.S. Navy, the U.S. Coast Guard, and U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with the numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Division staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspaper, staff members participated in National Wildlife Week, Chamorro Week, Earth Week and Environmental Fair activities and gave talks to a number of civic groups, sportsman clubs, and school and university classes.

Some specific Technical Assistance activities included:

1. The Division was represented on the Development Review Committee, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning. Most recently, land and resource rights have become a controversial issue; prompting the Division to question the feasibility of certain mega-acreage proposals from a regional perspective. In review of proposals for new developments, Division staff have been focusing on more cumulative impact concerns such as regulated usage of pesticides, degradation of watershed systems, and loss of ravine and limestone forests.
2. The Division reviewed and commented on ACOE applications for wetland fill for the Island Equipment Company, Talofoto Golf Resort, Manenggon Hills Resort, STT Golf Resort, Cascada Golf Resort, Guahan Golf Resort, Tinechong Golf Course (FBD), Dan Dan Estates and Guam First Green Golf Course. Mitigation recommendations were included in these comments. Comments and concerns were also provided to various local agencies.
3. The Division provided comments to local enforcement agencies regarding several wetland violations -which are still pending investigation- within single family residences within the Utan Tano area, various areas in Mongmong-Toto-Maite bordering the Agana Swamp, Chalan Pago as well as isolated areas throughout the island.
4. Recently passed Public Law 21-82 allows property owners of 2 acres or less to rezone their land to R-2 (multi-family) by bypassing existing zone change procedures, which can result in an approval or disapproval of such a request within 30 days. As of the end of FY92, TAP has reviewed 7 of these "fast-track" zone change applications.
5. Division staff participated with both federal and local agencies in wetlands delineation surveys of the Guam First Green Golf Course, Manenggon Hills Resort -including the four-mile Manenggon access road, United Light Industrial Park, and the Talofoto Golf Resort. Division staff also made mitigation recommendations regarding these projects.
6. The Division reviewed and commented on numerous Environmental Impact Statements/Assessments of proposed developments. These comments included recommendations for grading and clearing, erosion control, project design and orientation. These recommendations were made to reduce and/or eliminate impacts to the immediate and adjacent environments.
7. The Division's Wildlife Section provided comments at the request of the USFWS involving several Section 7 Consultations under the Endangered Species Act.

8. The Division's Wildlife and Fisheries Sections provided assistance and information to the Technical Assistance Program on various area of significant environmental concern.
9. The Division conducted additional of the proposed ABC Condominium Dredging Project and revisions thereof.
10. The Division reviewed and commented upon a number of permit requests for development on Cocos Island by Cocos Lagoon Development Corporation (CLDC). These included the masterplan modification for the Cocos Island Resort, CLDC use of the Government of Guam LCM ramp, the periodic maintenance dredging in the channel for an existing LCM ramp as well as an after the fact permit for the existing ramp, construction of a concrete and wooden cabana structure, construction of a jet ski ramp, installation of five storm moorings in Cocos Lagoon, and construction of new LCM ramp at Cocos Island. In addition, the Division participated in the review of CLDC's proposal to restore the northern portion of Cocos Island by recovery of sand washed off the island by Typhoons Russ and Yuri, construction of an additional seawall on the seaward side of the island to provide protection against future storm wave damage, and removal of post-typhoon debris. The prime concern in the review of all these activities was their potential impact on the existing avian colonies and on sea turtle nesting.
11. The Division participated with, and provided comments and assistance to, the Guam Environmental Protection Agency and the Office of the Attorney General in negotiations with Miyama Development Incorporated (MDI) regarding water rights issues.
12. The Division offered comments to, provided information to, and participated in the Western Pacific Regional Fisheries Management Council (WESPAC) and the Plan Monitoring Team (PMT) on projects for bottom and pelagic fisheries. Information was provided on market sampling, biomass and stock assessment, historical and current transshipment from foreign and domestic vessels, recreational and near-water commercial vessels and public service announcements.
13. The Division reviewed and commented on several legislative bills that would affect fish and wildlife.
14. The Division reviewed and commented on several proposals to dispose of government land through sale, exchange or lease and made appropriate recommendations for the conservation of wildlife resources.
15. The Division met with Government agencies and provided information on several occasions regarding the user conflict between mechanized craft and fishermen in East Agana Bay.
16. The Division investigated several reports of suspected fish kills in island waters during the year.
17. The Division responded to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing and importation of wildlife.
18. The Division responded to many requests for information on native wildlife, particularly endangered species.

19. The Division answered numerous requests for information on hunting from both on and off-island individuals. Specific requests included information on hunting areas, hunter safety classes, firearms regulations, hunting seasons and limits, and laws and regulations.
20. Division staff provided technical assistance to numerous farmers and the Air Force and Navy regarding pig damage. Damage control permits were issued when warranted.
21. Division staff reviewed manuscripts for other authors and for professional journals.
22. The Division provided technical assistance to the Attorney General's Office in interpreting the laws and regulations that apply to fish and wildlife resources. In addition, the Division requested for several legal opinions in regards to environmental issues.
23. The Division requested a legal opinion on eminent domain and the taking of government property pertaining to CLDC reclamation attempts of submerged beach soils at Cocos Island Resort.
24. Division staff attended hunter safety briefings at Anderson Air Force Base and the Mangilao Community Center to provide pertinent information to hunters.
25. Division staff made numerous presentations on fish and wildlife resources at meetings of numerous and other organizations during the year.
26. Division staff prepared numerous press releases to keep the public informed of fish and wildlife issues including hunting and hunting seasons, Brown Tree Snake issues, fish and wildlife laws and regulations, endangered species, fish and wildlife importation, etc.
27. Technical assistance was provided to the Guam International Fishing Derby.
28. Technical assistance and logistic support was provided to various U.S. Fish and Wildlife Service personnel working on the brown tree snake problem.
29. The Division participated with local and federal agencies during National Wetland Week.
30. The Division, at the request of numerous developers, met with them, their consultants and other government representatives to discuss their proposed development and its possible impacts on endangered species, wetlands and native habitat as well as erosion, project design, etc.
31. Division staff provided technical assistance to U.S. Fish and Wildlife Service and National Marine Fisheries Service law enforcement personnel on various matters including the importation of endangered species items.
32. Division staff participated with Division of Natural Resources at Rota on surveying *Serrianthus nelsonii*.
33. Division staff provided technical assistance to management personnel at Cocos Island to prevent the introduction of the Brown Tree Snake to Cocos Island.

34. Division staff provided technical assistance to the Republic of Palau and the U.S. Fish and Wildlife Services by writing the final report on a survey for fruit bats in Palau.
35. Division staff assisted mandated Government of Guam Departments/Agencies in monitoring and inspecting conditions imposed in permits approved by the Territorial Land Use Commission and the Territorial Seashore Protection Committee. Comments on violations were submitted to various Government of Guam departments/agency for review and action.
36. In collaboration with GEPA, the Division reviewed and submitted comments on one-hundred and sixty (160) Government of Guam Clearing and Grading permit applications, thirty-three (33) of which have been approved with stringent conditions recommended by the Division.
37. Technical advice on wetland have been provided to the Development Review Section at GEPA. In addition, TAP participated on several wetland verification and delineations with GEPA to include the Army Corps of Engineers.
38. The Division reviewed and submitted comments on the proposed Guam Sports Complex in Harmon, Guam.
39. The Division provided input regarding candidate sites for conservation and marine reserves, including a Marine Conservation Area proposed by Andersen Air Force Base.
40. Division staff submitted various correspondence regarding wetland violations. Such Correspondence included participation in the federal prosecution of an individual for filling wetlands in Mongmong-Maite-Toto.
41. Divisional staff submitted a total of 5 Agricultural Impact Statements to the Territorial Land Use Commission, as per Government of Guam requirement for Zone-Change application from agricultural zones to zoning for other land uses. These impact statements included several environmentally sensitive and controversial areas.
42. Divisional staff submitted over 115 position statements on various submerged land/land use issues as per requirement by the Government of Guam Development Review Committee.
43. The Division provided comments to the Government of Guam Bureau of Planning regarding Federal Consistency Application for the structural improvement of X, Y, and V Pier at Apra Harbor, to include improvements by dredging at Reserve Craft Beach and the Commercial Port.
44. The Division provided comments to the Regional Fisheries Training Project regarding the draft South Pacific Commission, Fisheries Human Resources Survey Guam Report.
45. The Division provided statistical data on fish and wildlife issues to the Bureau of Planning and Department of Commerce as supplemental information for local annual reports.
46. The Division continues its review regarding the Habitat and Reclamation Plan for the Talofofo Fish ponds.

47. The Division anticipated in the observation and submitted comments to the USFWS and GEPA on the U.S Navy attempt to remove submerged pilings by blasting at SRF Dry Dock Facilities.
48. The Division participated in meetings and submitted recommendations on U.S. Navy's proposal to refurbish mooring for mooring buoys in Apra Harbor. Also, provided comments and collaboration with GEPA and University of Guam, Marine Lab on the protection and assessment of damaged coral and sponge flats.
49. The Division participated in Mine Exercises conducted by U.S. Navy.
50. The Division provided comments to the Department of Land Management regarding the proposed land lease of government land at Oka Point, Tumon.
51. The Division reviewed and submitted comments on various drafts regarding the I Tano Ta Land Use Plan proposal to implement new land use alternative through performance standards.
52. The Division reviewed and submitted comments on the Guam Telephone Authority proposal to erect a cellular phone antenna on Mount Sasalaguan.
53. The Division conducted site verification of wetland areas in Conga, Sinajana.
54. The Division provided comments and recommendation on reconfiguring project footprint to accommodate protection of wetland areas at the Pacific Light Industrial Park at Ordot.
55. The Division conducted site verification and provided comments on wetland areas on John Russell property in Mangilao.
56. The Division reviewed and submitted comments on Manenggon Hill Project request to construct an effluent pipe at the confluence of the Manenggon and Ylig River.

Report prepared by: Marvin G. Aguilar

JOB PROGRESS REPORT INFORMATION/EDUCATION PROGRAM

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: C-3

JOB NO.: 1

JOB TITLE: Public Information and Education on Guam's Fish and Wildlife Restoration and Endangered Species Programs.

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

The Division's Public Awareness and Conservation Program expanded its outreach program this year to include not only public and private schools but two summer camps as well. Of the 2256 youths addressed, approximately 400 of those were from the Department of Parks and Recreation Summer Camp and the Southern Summer Youth Development Program. The remainder came from 84 elementary, middle and secondary classrooms. This is the first year that educational presentations have extended to summer camps.

The 2nd Annual Fena Lake Fishing Derby (*For Kids Only*), was held on the U. S. Naval Magazine on March 21 and 22, 1992. The derby drew more participants than the previous year, although only 103 were accommodated due to space restrictions. Due to manpower shortage in the Fisheries Section, the Division did not conduct a marine derby.

An estimated 10,000 to 15,000 residents viewed Division displays during this fiscal year. Television Public Service Announcements continue to be aired on public and network television. Information pamphlets, activity guides and coloring books were also reprinted. Other projects completed include the endangered bird mounts and posters, both joint projects with the Commonwealth of the Northern Marianas' (CNMI) Fish and Wildlife Division.

The Wildlife Trade display put together by the Region I Division of Education, Publications, Interpretation, and Cultural Resources (EPIC) with input from our Division, was partially completed and is now on exhibit in the well-wishers' lounge at the A. B. Won Pat International Airport.

Finally, the first-ever Pacific Islands Aquatic Resources Education Workshop, sponsored by Federal Aid staff from Region I, was held on Guam for aquatic education specialists and coordinators from American Samoa, the Commonwealth of the Northern Marianas (CNMI), Hawaii and Guam.

BACKGROUND

The DAWR Public Awareness and Conservation Education Program (PACE) was established in conjunction with DAWR's mission to preserve, develop and enhance Guam's aquatic and wildlife resources. The program consists primarily of school

presentations, public service announcements, press conferences and news releases, public displays, periodical newspaper columns, feature articles, information pamphlets, coloring books and activity guides for elementary school children.

In FY '90, the PACE program was expanded to include the Division's Conservation Officers (COs) as school presenters, thus enabling the Division to not only cover more schools but to address the enforcement aspects of conservation education.

The effectiveness of these programs and activities can best be measured by the community's continuing response in reporting suspected poachers and poaching activities to conservation officers and police, and the increase in teacher requests for fish and wildlife presentations. As in the past, residents continue to report forest bird sightings, bring in injured birds or birds presumed to be endangered species, and generally to encourage the institution of more intensive management programs for Guam's fish and wildlife resources.

PROCEDURES AND RESULTS

To date, activities and efforts include:

1. The 2nd Annual Fena Lake Fishing Derby (For Kids Only) emphasizing conservation ethics and safety, was held on the U. S. Naval Magazine on March 21 and 22, 1992. The two-day event, which drew a total of 103 participants from ages seven through 12, was sponsored by the Division in conjunction with the U. S. Naval Magazine Command. Unlike the previous year's catch and release derby, this year's event allowed anglers to keep two of their catch measuring 10 inches or longer. Although there were no "keepers" recorded, fun was had by all who participated. Prize ribbons were given to the top three winners in three categories: Most Fish, Longest Tucunare and Longest Tilapia. Certificates of participation were given to all participants. Donations were received from Burger King which provided coolers, ice, punch and cups for both days, and National Office Supply which donated the certificates of participation.
2. Educational presentations to 1856 youths from 84 classrooms (11 elementary and 5 middle and high schools) and 400 participants from four summer youth camp sessions operated by the Department of Parks and Recreation and the Southern Youth Development Program. Summer participants ranged from 5 through 16 years of age. Presentations were complemented by a display of live and preserved animals, followed by a question-and-answer period.
3. Displays on the Brown Tree Snake and fish and wildlife conservation were shown during Earth Week, University of Guam Charter Week, and Clean Water Week. An estimated 10,000 to 15,000 residents viewed the displays.
4. Television Public Service Announcements (PSAs) continue to be aired on network and public television, and Division programs and activities continue to gain extensive media coverage.
5. Reprinting of information pamphlets on the Brown Tree Snake, the Fish and Wildlife Activity Guide and the Wildlife Coloring Book for public distribution.
6. Completion of endangered bird mounts for office and travelling displays. The project is a cooperative project with the CNMI Fish and Wildlife Division which gathered the specimens.

7. Coordination and partial completion of the Wildlife Trade display, a project of the U. S. Fish and Wildlife Service with input from the Division, at the A. B. Won Pat International Airport. The display is expected to be completed within the next fiscal year.
8. The printing of 15,000 sets of posters on forest, land, sea, shore and water birds common to Guam and the Northern Marianas. Distribution to all public and private schools, libraries, departmental offices, hospitals, hotels and other institutions is underway. The project is a cooperative project with the CNMI Fish and Wildlife Division which received 3,000 sets.
9. Division participation in Student Career Day, Science Fairs and Youth Leadership Day activities at various high schools.
10. Division participation in the first-ever Pacific Islands Aquatic Resources Education Workshop, sponsored by Federal Aid staff from Region I. Participants included aquatic education specialists and coordinators from American Samoa, Hawaii, the CNMI and Guam. Facilitators of the workshop included Mr. Ernest Kosaka and Ms. Tammy Petersen of the U.S. Fish and Wildlife Service Federal Aid staff in Portland, Oregon; Mr. Mike O'Malley, Aquatic Resources Education Specialist in the state of Washington, and Mr. Barry Smith, Sea Grant Coordinator-University of Guam Marine Lab.

The group agreed to develop joint projects adaptable to island ecosystems including a video documentary and workbook on coral reefs. Ms. Pam Knudsen of American Samoa was named project coordinator; Mr. Randy Honebrink of Hawaii was tasked with leading the production of the projects.

11. Development of press releases and media conferences focusing on DAWR's programs and activities;
12. Administrative duties as assigned by the Division Chief and Assistant Chief.

RECOMMENDATIONS

1. Immediately implement the planned Aquatic Education Leadership Workshop for public and private school teachers. A syllabus has been developed by DAWR and prospective workshop facilitators from the University of Guam's Marine Lab. All that remains is the coral reefs workbook (currently being developed by participants of the Pacific Islands Aquatic Resources Education Workshop) which DAWR intends to incorporate into its AE program.
2. Continue both freshwater and marine derbies for kids and initiate an adult freshwater fishing derby. The kids' freshwater Derby is rapidly gaining popularity and it appears that the Division may have to consider conducting two such derbies in order to accommodate more kids within the higher age levels. Such a decision would of course, be subject to approval by U. S. Naval Magazine officials.
3. Continue fish and wildlife presentations at schools and libraries, both public and private, and other organizations.

4. Expedite the approval of Guam's new fishing and hunting regulations to facilitate the publication of a multi-lingual pamphlet to better educate and inform Guam's culturally-diverse and multi-ethnic community.
5. Continue public awareness program through press releases, news articles, press conferences and other media to keep the public informed of the progress and accomplishments of the Division's fish, wildlife and endangered species programs.
6. Secure funding for the erection of international signs at major beaches throughout Guam and other sites frequently victimized by coral and fishing violators.
7. Develop a 30-minute educational video documentary on DAWR's programs and activities for public broadcast and dissemination to all public and private education institutions.
8. Develop fish and wildlife conservation flyers and bumper stickers, posters on the Marianas Fruit Bat, Brown Tree Snakes and development of other materials.
9. Encourage and support the creation of and actively participate in the activities of an education/information network comprised of educators and resource persons from environment-oriented departments and agencies.
10. Coordinate the Division's participation in mutual programs and projects with Guam's Department of Education, Coastal Zone Management, Sea Grant, the University of Guam Extension Service, Department of Parks and Recreation, and the Environmental Protection Agency.

Report prepared by: Lillian L. Mariano

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29
SUB-PROJECT NO.: F-1
STUDY NO.: 1
JOB NO.: 1

STUDY 1: Fisheries Participation, Effort, and Harvest Surveys

JOB TITLE: Offshore Fisheries Survey

PERIOD COVERED: October 1, 1991 to September 30, 1992.

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin and other boat launching locations along Guam's shoreline from October 1991 through September 1992. An island-wide finfish catch from small recreational-type vessels is estimated at 338.2 metric tons (MT) for that period. An estimated 312,536 person-hours were spent during 90,014 boat-hours of fishing. The bulk of the catch, 286.8 MT, was landed by trolling during an estimated 61,971 boat-hours of effort. Nearly all of the troll catch, 97.3%, consisted of five major pelagic species. Bottomfishing produced an estimated 23.4 MT, , and night-light jigging for atulai produced an estimated 6.0 MT. Spearfishing produced 16.1 MT of finfishes and shellfish. Approximately 5.7 MT of finfish and shellfish were caught by spin-casting, hand or gill net. Catches by infrequently encountered methods may be under-estimated as follows: bottomfishing (2%); spearfishing (17%); nightlight jigging for atulai (15%); and all other methods combined (29%).

BACKGROUND

Effective management of the island's offshore fishery resources requires accumulating data on fishing pressure, types of fishing methods used and annual harvest. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlife Resources (DAWR) has been monitoring offshore fishing activities for the past 15 years. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. During the early 1980s major advances were made in both field survey techniques and in the area of computerized statistical analysis. The combined efforts of DAWR and National Marine Fisheries Service (NMFS) personnel through the Western Pacific Fisheries Information Network (WPACFIN) program (see Study F-1, Job 3) made it possible to employ computerized statistical analysis for the period FY '77-91. However, statistics could not be computed for FY '92 estimates due to attrition of critical staff.

OBJECTIVES

1. To quantify fishing participation, effort, and catch which occurs outside the reef margin in boats.
2. To collect biological data from the specimens examined during interviews.

PROCEDURES

During FY '92, interviews of returning offshore fishing parties were conducted on four days each month at the Agana Boat Basin. Two of these days were randomly selected weekdays and two were randomly selected weekend days (which, in this report, includes holidays). Each survey consisted of two periods, one from 0500 to 1200 hours (previously to only 1100 hours) and the other from 1600 to 2400 hours. In addition, interviews from the southern launching site of Merizo Pier were obtained on one day per month, alternating between weekdays and weekends from the hours of 0600 to 1100 and 1600 to 2000. Island-wide participation was determined by means of a morning and evening survey of all public boat launching areas in which all trailers attached to vehicles were counted, but no interviews were taken. This assumes that the proportion of boat trips participating in fishing to boat trips not participating in fishing as well as the proportion of boats engaging in each method for boats utilizing the Agana Boat Basin is representative of the island as a whole.

Sampling and analytical procedures used in the GOES (Guam Offshore Expansion System) remain unchanged from those of recent years for the months October through December 1991. However, drastic attrition in critical staff made it impossible to employ the GOES for the remainder of FY 92. Preliminary estimates for the remaining months without statistical analysis were determined through the use of a computerized spreadsheet. The following steps were taken to obtain monthly estimates of total participation, effort, catch, and total number and weight for the five major trolling species (mahimahi, wahoo, skipjack tuna, yellowfin tuna, and blue marlin) for each method:

1. Participation, effort, catch, and total number and weight for the five major trolling species (mahimahi, wahoo, skipjack tuna, yellowfin tuna, and blue marlin) for each method and returning boat were summed for each survey day.
2. Totals for each survey day were divided by that days P1 and P2 values to obtain an island-wide estimate. The method for determining P1 and P2 values remained unchanged from that of previous years.
3. The average of each daily parameter for each type day (weekday [WD] or weekend/holiday [WE/H]), was multiplied by the number of each type day in the month to obtain WD and WE/H monthly estimates. WD and WE/H totals were summed to obtain monthly totals.
4. Estimates for the month of July and for the year for trolling and bottomfishing are based on a 28-day expansion, with the Guam International Fishing Derby (GIFD) results added for trolling (Appendix).
5. Summary estimates for the remaining methods are based on 31-day and 366-day expansions for July and the year, respectively. Other one and two-day derbies with relatively low turnouts were not considered separately from the normal expansion.
6. The method used to assess the degree of under-sampling remained unchanged from that of the previous year.

RESULTS

Trolling

Including the Guam International Fishing Derby (GIFD; Appendix 1) an estimated 286.8 MT of troll-caught fish were landed island-wide during FY '92 (Table 1). Monthly catches ranged from a high of 42.5 MT in June to a low of 7.4 MT in October (Figure 1). An estimated 61,971 boat-hours were spent trolling with an average catch rate of 4.6 kg/boat-hour. Monthly catch rates as catch per unit of effort (CPUE), ranged from 3.0 kg/boat-hour in October to 6.1 kg/boat-hour in September.

The usual five pelagic species accounted for the bulk of the catch (97.3%; Table 2) with each species accounting for approximately equal portions of the catch. Blue marlin (*Makaira nigricans*; 21.0%) was the most important species, followed by mahimahi (*Coryphaena hippurus*; 20.0%), skipjack tuna (*Katsuwonus pelamis*; 19.9%), yellowfin tuna (*Thunnus albacares*; 19.4%), and wahoo (*Acanthocybium solandri*; 17.0%).

The estimated troll fisheries catch for FY '92 decreased by 21% from the record catch of the preceding year. The drop in catch can be attributed primarily to the poor run of mahimahi (57.2 MT) which was only 32% of that of last year. The blue marlin catch of 60.3 MT remained about the same as those of the last two years. The skipjack tuna catch was only about 3% larger than that of last year, but the wahoo and yellowfin tuna catches were 100 and 134% larger, respectively.

New records for participation and effort were set during FY '92 (68,657 person trips, 61,971 boat hours, and 261,123 person hours). This combined with the decreased in the catch of mahimahi contributed greatly to the relatively low overall catch rate of 4.2 kg/boat hour. These figures are consistent with the charter boat segment of the troll fishery continuing its rapid growth, outpacing that of the non-charter segment. Charter vessels generally carry more people but spend less time fishing per trip than non-charter vessels. Their larger size enables them to go out more often even during marginal weather conditions and they target marlin more frequently than non-charter vessels.

Bottomfishing

An estimated 23.4 MT of bottomfishes were landed island-wide during FY '92 (Table 3). Estimated monthly catches ranged from a high of 6.7 MT in May to a low of 29 kg in March. Bottomfish landings fluctuated widely, with catches of less than 1 MT occurring in October, January, March, April, June, and September. An estimated 29,996 person-hours were spent during 11,465 boat-hours of bottomfishing, resulting in an overall catch rate of 2.0 kg/boat-hour. Monthly catch rates ranged from <0.1 kg/boat-hour in January and March to 3.8 kg/boat-hour in August.

Estimated bottomfishing participation, effort, and catch for FY '92 were slightly higher than those of the past two years. Composition of the FY '92 catch has not been determined, but is not expected to differ from that of the past few years. It is believed that the expansion method used underestimated the participation, effort, and catch for this method by about 2%.

Spearfishing

Estimated monthly and annual participation, effort, and catch for spearfishing from boats during FY '92 are summarized in Table 4.

An estimated 16.1 MT of speared fish, crustaceans, and mollusks were landed from boats during FY '92, 13% less than that of the preceding year but considerably higher than the highest catches of other recent years.

The bulk of the catch (58.6%) was taken by scuba diving although twice as much effort in terms of person-hours (7,129 vs. 3,544) was attributed to snorkeling. The overall catch rate for spearfishing in FY '92 was only 1.5 kg/person hour with the catch rate by scuba diving triple that by snorkeling (2.7 vs 0.9 kg/boat hour). This represents a dramatic drop in catch rates from the previous year. However, although no confidence limits could be placed on the FY '92 estimates, few of the differences between annual estimates in recent years are significant at even the 90% level of confidence. Composition of the FY '92 catch has not been determined, but is not expected to differ from that of the past few years. It is believed that the expansion method used underestimated the participation, effort, and catch for this method by about 17%.

Atulai Night-Light Jigging

Atulai (*Selar crumenophthalmus*) fishing was encountered during the months of November and February through July.

An estimated 6.0 MT of fish were landed by night-light jigging during 11,465 boat-hours of effort during FY '92. This is 41% lower than last years catch, but the effort was five times that of FY '91. This is consistent with a pattern of wide fluctuations in catch, effort, and catch rates for this fishery. Although composition has not yet been determined, nearly all of the observed catch consisted of atulai (*Selar crumenophthalmus*). It is believed that the expansion method used underestimated the participation, effort, and catch for this method by about 15%.

Other Methods

Other rarely encountered methods during FY '92 included gill-netting, spin-casting from an anchored boat, and by hand (the latter method may utilize a knife or hand tool or no equipment at all). Together, they produced an estimated catch of 5.7 MT of finfishes and shellfish during 2,159 boat-hours and 6,529 person-hours of effort. It is believed that the expansion method used underestimated the combined participation, effort, and catch for these methods by about 29%.

RECOMMENDATIONS

There is little doubt that the reliability of estimates of island-wide catch and effort based on the present survey is limited by the quality of participation data taken at sites other than the Agana Boat Basin under the assumption that activity as well as catches landed there are representative of the island as a whole. However, data collected at Merizo Pier during FY '89-'91 indicates that this is not the case, but that there is proportionately much less trolling activity and much more bottomfishing, spearfishing, and gillnet activity occurring there. We still do not have a clear idea how much boating participation takes place from less accessible landings (e.g. the private Achang Bay Marina), nor do we know the proportionality of the various methods at these areas or at the Agat Marina. Island-wide estimates for the past several years are therefore disproportionately high for trolling, but low for other methods. Since these other methods are the only ones that are locally manageable, it is imperative that the survey results be unbiased as well as based on an adequate sample of interviews from launch sites other than the Agana Boat Basin. Separate expansions for the Agana Boat Basin and other boat launching sites would be desirable. It

will also be necessary to reassess annual island-wide estimates of catch and effort as far back as possible.

Since all major trolling species have broadly distributed stocks, some of which are believed to be Pacific-wide, meaningful management and conservation of these resources will only be possible by international regional cooperation. This will require that data bases be made available from as many sources and areas as possible, and that any biological assessment be based on adequate region-wide data. There are presently few areas from which adequate data on recreational or subsistence fisheries are available, significant gaps in the data for both foreign and domestic distant-water fisheries, and virtually no information on the interaction of recreational and large-scale commercial fisheries. It is therefore essential that the current time-series of data from Guam be maintained. Since Guam's recreational troll fishery is incapable of taking more than a fraction of a percent of these stocks and could not have an adverse affect on them, and since the activities of both domestic and foreign large-scale commercial fisheries can significantly affect the performance of Guam's recreational fishery, it is imperative that Guam's recreational fisheries interests be represented and protected in any regional forum.

In order to effectively manage those fisheries that are specific to Guam, or to Guam and nearby islands and banks, additional biological information is needed on major bottom- and spearfished species. The offshore survey is currently too infrequent to obtain sufficient data to perform certain length-based analyses of any of these species. It is recommended that separate studies of the major bottomfish species be implemented that examine reproduction and ecology as well as length-frequency distributions. Comparisons with the inshore survey will have to be made to determine which spearfished species require further study.

In order to address the problems described above, the following projects have been implemented or proposed:

1. The GOES program will be rewritten and modified for use on the data base software "4th Dimension" on the fishery section's Macintosh SE/30 computer system. Dr. Steven Amesbury of the University of Guam Marine Laboratory is currently under contract to prepare the new GOES program. Modifications expected in the GOES will: (1) enable the program to produce more accurate expansions that factor in days in which a given method occurred but no interviews were obtained; (2) produce separate estimates for shallow- and deepwater bottomfisheries; and (3) use additional location codes to more accurately distinguish between trips that include or exclude offshore banks. The software and hardware itself will greatly reduce the time needed to produce expansions as well as greatly reduce risks of input or transcription errors by making it possible to save subsets and files without having to re-enter variables, and by eliminating the need for dumping compiled summary data on other software in order to produce tables and charts. This will make it possible to quickly and efficiently examine many aspects of the data base that are impractical to exam under the current system as well as make it possible to re-expand the historic data base using more accurate information on participation.
2. A separate, intensive study of Island-wide participation in small-boat fisheries on a method and area-specific basis in order to produce more accurate island-wide expansions should be conducted.
3. Studies of the major bottomfish species *Epinephelus fasciatus*, *Variola louti*, and *Lethrinus rubrioperculatus* that examine reproduction and ecology as well as length-frequency distributions to be initiated under the D-J funded project "Studies of Recreationally Important Reef Fish" (project no. FW-2R Job F-1).

4. An increase in staffing (two Technician and a Data Processing Biologist) to adequately cover the Agat Marina and other launch sites while maintaining the current level of coverage at the Agana Boat Basin.

Therefore, we recommend that this job continue, that sampling techniques continue to be refined or expanded as necessary, and that historic annual estimates of catch and effort be reassessed. We also recommend that staff fisheries biologists continue to work closely with NMFS personnel in improving the efficiency and accuracy of our computerized data analysis techniques, and that they take an active roll in regional management activities through the Council and other regional organizations.

Report prepared by Robert F. Myers

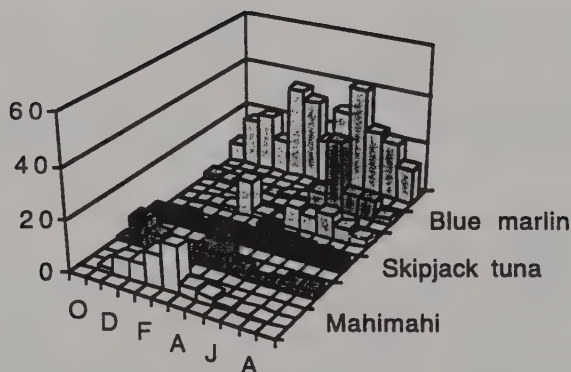


Figure 1

Monthly composition of the Guam trolling catch during FY '92. Estimates include the Guam International Fishing Derby (GIFD). Weights are in metric tons (MT).

Table 1. Estimated monthly trolling participation, effort, and catch during FY '92. Estimates include the Guam International Fishing Derby (GIFD). Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	No. of Persons	No. of Boat hours	No. of Person hours	No. of Kilograms	Kg/ per- son	Kg/ boat- son	Kg/ person- hour	hour
OCT	2,914	2,463	12,540		7,441	2.6	3.0	0.6
NOV	3,892	3,297	17,297		19,035	4.9	5.8	1.1
DEC	4,944	5,379	2,838		22,630	4.6	4.2	8.0
JAN	4,964	3,404	16,798		13,388	2.7	3.9	0.8
FEB	10,639	8,845	40,456		36,807	3.5	4.2	0.9
MAR	5,546	5,676	23,499		33,131	6.0	5.8	1.4
APR	7,003	5,113	27,583		17,606	2.5	3.4	0.6
MAY	7,074	6,348	28,178		31,138	4.4	4.9	1.1
JUN	7,312	7,141	33,792		42,524	5.8	6.0	1.3
JUL	6,923	7,478	30,076		25,884	3.3	3.7	0.9
AUG	4,720	4,517	18,413		23,277	4.9	5.2	1.3
SEP	2,726	2,311	9,653		13,986	5.1	6.1	1.4
TOTAL	68,657	61,971	261,431		286,848	4.2	4.6	1.1

Table 2. Monthly composition of the Guam trolling catch during FY '92. Estimates include the Guam International Fishing Derby (GIFD). Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	Mahimahi	Wahoo	Skipjack tuna	Yellowfin tuna	Blue marlin	other
OCT	131	929	3,575	245	1,924	637
NOV	1,567	11,236	4,083	921	953	275
DEC	7,018	6,929	5,463	1,266	1,790	164
JAN	7,637	1,909	2,000	1,576	0	266
FEB	12,806	4,102	4,451	14,352	0	1,081
MAR	17,960	7,107	4,211	2,170	1,134	673
APR	4,486	7,043	2,881	1,082	1,833	281
MAY	3,145	2,649	10,271	8,869	5,779	424
JUN	1,363	170	5,877	6,562	28,396	468
JUL	549	1,011	5,078	9,467	8,416	486
AUG	390	2,957	4,620	5,688	7,879	1,749
SEP	173	2,816	4,482	3,425	2,229	861
FY '92	57,225	48,858	56,992	55,625	60,334	6,289

Table 3. Estimated monthly bottomfishing participation, effort, and catch during FY '92. Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	No. of Persons	No. of Boat hours	No. of Person hours	No. of Kilograms	Kg/ per- son	Kg/ boat- son	Kg/ person- hour	hour
OCT	453	1,209	2,626		1,101	2.4	0.9	0.4
NOV	492	735	2,228		2,351	4.8	3.2	1.1
DEC	1,138	799	2,838		2,022	1.8	2.5	0.7
JAN	258	592	508		42	0.2	0.1	0.1
FEB	1,149	1,211	3,099		1,461	1.3	1.2	0.5
MAR	144	852	1,010		29	0.2	<0.1	<0.1
APR	491	319	1,117		675	1.4	2.1	0.6
MAY	1,115	1,946	5,851		6,696	6.0	3.4	1.1
JUN	568	662	1,917		552	1.0	0.8	0.3
JUL	968	1,307	3,850		1,968	2.0	1.5	0.5
AUG	993	1,611	4,227		6,071	6.1	3.8	1.4
SEP	275	223	725		484	1.8	2.2	0.7
TOTAL	8,044	11,465	29,996		23,452	2.9	2.0	0.8

Table 4. Estimated monthly offshore spearfishing (with and without scuba) participation, effort, and catch during FY '92. Weights are in kilograms (1 Kg = 2.2046 lbs).

MONTH	No. of Persons	No. of Boat hours	No. of Person hours	No. of Kilograms	Kg/ per- son	Kg/ boat- son	Kg/ person- hour	hour
OCT	140	35	140		73	0.5	2.1	0.5
NOV	208	104	312		827	4.0	8.0	2.7
DEC	67	19	47		53	0.8	2.8	1.1
JAN	40	24	56		2	0.1	0.1	<0.1
FEB	372	270	1,043		755	2.0	2.8	0.7
MAR	308	183	683		977	3.2	5.4	1.4
APR	361	125	437		700	1.9	5.6	1.6
MAY	1,940	484	2,072		5,375	2.8	11.1	2.6
JUN	7,124	7,078	1,064		2,821	0.4	0.4	2.7
JUL	566	559	1,681		3,618	6.4	6.5	2.2
AUG	132	236	3,138		937	7.1	4.0	0.3
SEP	0	0	0		0	-	-	-
TOTAL	11,257	9,117	10,673		16,138	1.4	1.8	1.5

APPENDIX 1

Guam International Fishing Derby

PERIOD COVERED: 10-11 July, 1992

INTRODUCTION

The sixteenth Guam International Fishing Derby (GIFD), sponsored by the Guam Visitors Bureau (GVB), was held on July 10 and 11, 1992. Awards were presented to the anglers who landed the first, second, third, and fourth heaviest fishes of the following species: blue marlin (*Makaira nigricans*), yellowfin tuna (*Thunnus albacares*), wahoo (*Acanthocybium solandri*) and mahimahi (*Coryphaena hippurus*). Awards were also given for the largest fish caught in a ladies category, in a children under age 16 category, and in a tourist category. Records were kept in an "other species" category by the DAWR.

PROCEDURES

In theory, the determination of GIFD statistics is based on complete catch reports from all participating boats and requires no expansion, but in practice, there are always a significant number of boats that do not provide catch information. Since the GOES Tournament Module requires a complete data set, it has not been used, and the estimated derby parameters were added to the GOES monthly and annual output by hand.

DAWR biologists were present at the single onshore check-out/check-in station at the Agat Marina. With the exception of berthed charter vessels operating out of Agana, the Agana Boat Basin and Merizo Pier were not included in the GIFD due to logistic constraints and safety considerations. A log of all departing and returning boats was kept and as many returning boats as possible were intercepted for interviews.

Parameters of participation and effort were determined by using daily averages in place of missing data wherever possible. This was done for number of fishermen, number of lines fished, and "down time" when determining hours spent fishing. For these parameters, daily data was missing for approximately 49 to 83% of returning boats, depending on the parameter and day. The number of boat trips and boat hours was known since a log of all departing and returning boats was kept.

Determination of catches required a subjective appraisal of what species were likely to be present in non-intercepted boats. Average daily catch rates by species were assigned to non-intercepted boats in order to determine daily totals. Catches of non-intercepted boats were assumed to contain only non-derby species. The proportion of returning boats intercepted ranged from 71% on the first day to 82% on the second day of the derby.

RESULTS

Participation

One hundred and nine boats made 210 fishing trips during the course of the derby. This was a 33% increase in the participation over that of last year. However the number of trips was about the same since there were only two instead of three days fished. There were an average of 3.4 anglers pulling an average of 4.1 lines per trip. The mean time spent on the water was 9.1 hours per boat trip, of which 8.5 hours were spent fishing. These figures reflect an early closing time of 1800 hours on both fishing days and are somewhat lower than those of the last two years.

Catch

A total of 4,060 kg of derby species were landed. This was the lowest total since 1986, but on a per day basis was very close to the record 6,274 kg caught in 1989 (Tables 2,3). The bulk (67%) of the catch consisted of blue marlin (2,715 kg). Including the by-catch of seven species which accounted for 62% of the fishes but only 19% of the weight, 531 fish weighing 5,040 kg were caught. The bulk of the by-catch consisted of skipjack tuna (860 kg) with the remainder consisting of 121 kg of shortbill spearfish, shark, barracuda, kawakawa, dogtooth tuna, and rainbow runner.

The mean catch per boat per trip was 24.0 kg., very close to the catch rate of last year's derby, and considerably less than the record catch rate of the 1989 GIFD. Like the overall catch rate, the catch rates for each of the derby species except mahimahi were slightly lower than those of last year's derby. The catch rate for blue marlin greatly exceeded those for all other species (16.5 vs 0.7 to 5.7 kg/boat-hour fished; Table 4).

Sixty-one blue marlin weighing 2,715 kg were landed during the 1992 GIFD. The mean weight of 64.6 kg was slightly larger than those of the last three derbies and the 152.4 kg winning fish was larger than those of the past two years.

Ninety-nine yellowfin tuna weighing 882 kg were landed. The mean weight of 8.9 kg was the highest since 1983, but the 29.5 kg winning fish was the third smallest in derby history. This is the third straight year of increasing mean size.

Thirty-eight wahoo weighing 322 kg were landed with a mean weight of 8.5 kg. The winning wahoo of 20.0 kg was typical of recent derbies.

The mahimahi catch of 23 fish was the third largest in derby history, and the total weight (132 kg) was the second largest. The 9.1 kg winning fish was smaller than all but one of the winners during the last 10 years.

Fishing areas

Usable locality data was obtained from 72% of the returning boat trips. This made it possible to compare catches and catch rates by area (Table 4). However, the small number of trips to some areas makes certain comparisons highly subjective. This was the second straight year in which most of the fishing effort was spent south of Agat Marina (all or part of 81% of the boat trips vs 28% north of Agat Marina). The vast majority (78%) of the boats fished one or more of the southern banks, with Galvez Bank being the most frequently visited. Most of the catch was also from the south, as well as the best overall catch rates for each of the derby species. However, the few boat trips specifically to the northern banks produced the highest catch rates for Blue marlin and mahimahi. The pattern of higher overall catch rates in the south was consistent with four of the five preceding years.

ACKNOWLEDGMENTS

The fisheries staff of the Division of Aquatic & Wildlife Resources (DAWR) wish to thank the competing anglers, the Guam Visitor's Bureau, and members of the fifteenth GIFD derby committee for their cooperation and assistance in providing the information that made this report possible. This cooperation not only makes our job easier and more enjoyable, but insures a more accurate collection of data and better information for the fisherman.

Report prepared by: Robert F. Myers

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: F-1

STUDY NO.: 1

JOB NO.: 2

STUDY 1: Fisheries Participation, Effort, and Harvest Surveys (2430)

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1991 to September, 1992. The total estimated inshore fisheries catch for this time period was 100.2 metric tonnes (mt), 94% of which were finfish (excluding mañahak and achenchon). Hook and line fishing was the most practiced method accounting for 49% of the total participation* or 34,289 participants. In terms of catch rate, gill netting was the most successful daytime method, yielding approximately 4.6 kg/gear-hour (gh) and a harvest of 26.3 mt, and drag netting was the most successful nighttime fishing method, yielding approximately 6.1 kg/gh and a harvest of 0.5 mt. Gill netting was the most successful day and nighttime method in terms of catch, yielding approximately 37.9 mt or 40% of the inshore harvest. The seasonal mañahak and achenchon fishery accounted for approximately 13% of the total finfish harvest or 12.8 mt.

Aerial Survey

The aerial survey report is included in Appendix 1.

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual catch. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatics and Wildlife Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational / subsistence fishing activities have come to be based on more reliable data analysis techniques.

OBJECTIVES

1. To establish baseline catch and effort data for reef fish species necessary to develop a fisheries management plan for Guam.

* All participation and effort statistics except total harvest exclude seasonal fisheries data.

2. To gather limited biological data that will add to a long-term historical data base on Guam's fish species, which can be used to identify fisheries that require more intense research for management purposes.

PROCEDURES

During FY92, day and night "inshore participation" surveys were conducted on four randomly selected days per month. These surveys entailed making visual observations of fishermen participation that included the reef zones and general locations that were fished within the more readily accessible portions of Guam's coastline (Fig. 1, locations 1-71). Based on data collected during nine non-consecutive years of aerial surveys conducted between FY63 and FY79, approximately 85% of Guam's inshore fishing activities is known to occur within this area. The starting location for each survey was selected at random and the "clockwise or counterclockwise" direction of driving was alternated between surveys. Observations were made while driving the route once without backtracking. These methods were applied for both day and night participation surveys.

During FY92, four "inshore-catch" survey days were selected per month. During these survey days, fishermen-intercept interviews were conducted to gather catch, effort, and species composition data for both day and night fishing. The day survey covered a six-hour interval (beginning at 0630 h) and the night survey covered a five-hour interval (beginning at 1900 h). Only one of three survey regions (Fig. 1) was selected for each "inshore-catch" day and fisheries data collection was restricted to that region. However, because of infrequently interviewed methods (i.e., surround net), representative samples were sometimes difficult to obtain. Therefore, if a particular fishing method was not observed within the selected survey area during the survey, one or both of the other two areas could be surveyed for that method.

Seasonal data on the bigeye scad (atulai) and the juveniles of fusiliers (achenchon), goatfish (ti'ao), jacks (i'e'), and rabbitfish (mañāhak), were acquired through actual participation and "inshore catch" surveys.

Because the coastal fishing participation and range has steadily increased over recent years, aerial surveys were reinstated around Guam during FY90 in order to update islandwide participation estimates. Aerial surveys for this reporting period were begun in October, 1991 and conducted twice monthly. The surveys were performed on regularly scheduled participation days (one weekday / weekend) and began on the hour, rotating through from 0800 h to 1200 h for each subsequent survey. Visual observations of the fishing methods, participants, gear units, and areas fished were recorded as done in the inshore participation survey. Other data collected during these flights include observations of marine mammals, turtles, sharks, offshore fishing activity, fish aggregation device (FAD) use, and other incidental information.

The FY92 inshore harvest estimates were calculated by a computer software package for Macintosh known as the 4th Dimension database program (4D). The 4D program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2)

RESULTS

During FY92, the estimated inshore harvest for day, night, and seasonal fishing around Guam was 113.0 mt. Finfish (excluding mañāhak and achenchon) accounted for 94% of total harvest or 100.2 mt. The seasonal mañāhak harvest in East Agana Bay was estimated at 6% of the total finfish harvest or 5.8 mt. The total fish catch (finfish and non-

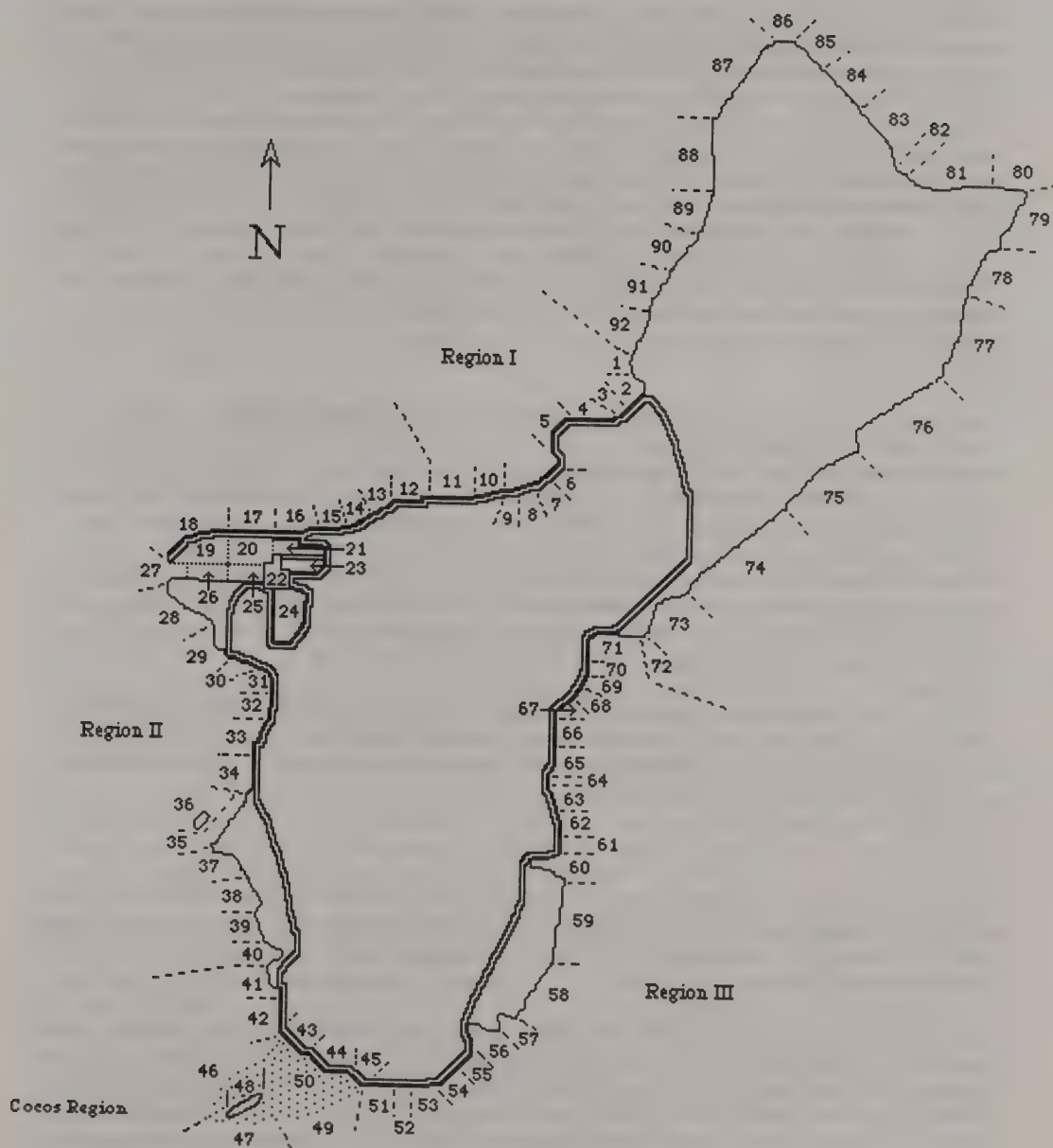


Figure 1. Inshore Fisheries "Participation Survey" Route and Location Codes.

finfish, excluding mañáhak and achenchon) resulted from a total effort of 274,418 person-hours (ph) and 245,495 gh. All methods combined, approximately 0.41 kg/gh of fish were harvested in FY92. Estimated participation, effort, and catch values for each fishing method are shown in Tables 1-3. The values in Table 1 are combined estimates of separate expansions of day, night, and seasonal catch data collections. Tables 2 and 3 present the participation, effort, and catch for day (Table 2) and night (Table 3) fishing for each method. Estimated catch composition for the top ten species and families of finfish harvested are shown in Tables 4-6. The listings in Table 4 are the top ten species and families caught for combined day and night catches. Tables 5 and 6 list the top ten species and families caught for day (Table 5) and night (Table 6) with all methods combined. Table 7 compares the top species and families harvested for day and night in FY88 and FY92. Table 8 lists the estimated mañáhak and achenchon harvest in selected areas for FY92. Tables 9-11 list the top species harvested by hook and line, gill net, and spearfishing with snorkel gear for day and night in FY92.

EFFORT

Hook and line fishing was the most practiced fishing method based on the total participation (combined day and night values), accounting for 34,289 persons or approximately 49% of the total participation. Gill netting was the second most practiced method overall accounting for 13,176 participants or 19% of the total participation, while cast netting followed in third with 10,596 participants or 15% of the total participation.

The rank order for day fishing participation placed hook and line first with more than two times as many participants as any other method with 24,933 or 50% participants. Cast netting and gill netting placed second and third respectively with 10,553 or 21% and 8,534 or 17% of the participants.

Hook and line remained the most practiced night fishing method with 9,356 participants or 48% of night participation. The second most practiced method was gill netting with 4,642 participants or 24%, while spearfishing with snorkel gear followed in third with 3,634 participants or 19% of night participation.

CATCH

Gill netting yielded the largest overall finfish catch with 37.9 mt or 40% of the total finfish harvest. Cast netting was second with 26.3 mt or 28%, while hook and lining was third with 20.6 mt or 22%, and spearfishing with snorkel gear was fourth with 8.1 mt or 9% of the total finfish harvest.

Due to approximately 77% of the total harvest^t resulting from day fishing, the top three methods for day harvest contributed 75% of the total finfish catch. Gill netting accounted for the most finfish with 26.3 mt or 35.9% of the day harvest. Cast netting was second with 26.2 mt or 35.8%, while hook and lining was third with 18.7 mt or 26%, and spearfishing with snorkel gear was fourth with 1.6 mt or 2% of the total day harvest.

Gill netting accounted for the most finfish caught at night with 11.6 mt or 74%, while spearfishing with snorkel gear and hook and lining accounted for 6.5 mt or 42% and 1.9 mt or 12% of the total night harvest respectively. Spearfishing with scuba gear was fourth with 0.8 mt or 5% of the total night harvest.

CATCH PER UNIT EFFORT (CPUE)

The CPUE values for the FY92 expanded daytime and nighttime harvests are included in the last column in Tables 1-3. Gill netting had the highest daytime CPUE of 4.58 kg/gh for weekday fishing surrounding netting followed in second for weekday fishing with 1.14 kg/gh. Cast netting was third for weekday fishing with 1.12 kg/gh.

Drag netting had the first and second highest nighttime CPUE of 6.12 kg/gh for weekend night fishing and 4.65 kg/gh for weekday nightfishing respectively. Gill netting had the third highest CPUE of 3.06 kg/gh for weekday nightfishing, while spearfishing with scuba gear followed closely with a CPUE of 3.03 kg/gh for weekday nightfishing.

The information concerning effort and harvest for methods not discussed are included in the summary Tables 1-3. Other nearshore fisheries harvests on Guam, including spearfishing with snorkel and scuba gear by boat, are recorded in the FY92 Offshore Fisheries Report (Study F-1, Job 1).

SPECIES COMPOSITION

The species composition for the FY92 expanded harvest for day, night, and combined efforts are presented in Tables 4, 5, and 6. The top day-caught seasonal species was the atulai, *Selar crumenophthalmus*, which accounted for approximately 42.2 mt or 58% of the day total with 52%, 64%, and 58% of the daytime hook and line, cast net, and gill net harvest respectively. In addition, the top night-caught species was the atulai, which accounted for approximately 4.9 mt or 21% of the night total and 41% of the total night gill net harvest. The top day-caught species (non-seasonal) was the scribbled rabbitfish, *Siganus spinus*, which accounted for approximately 5.8 mt or 8% of the day total. The top night caught species (non-seasonal) was the red lip parrotfish, *Scarus rubroviolaceus*, which accounted for approximately 2.9 mt or 12% of the night total.

Spearfishing with scuba did not account for a significant amount of fish caught during the survey period, despite the high catch rate using this method. The main reason for this occurrence is that a greater percentage of night scuba spearfishermen are difficult to encounter during a survey and many of them go to the outer reefs, e.g., Double Reef or outer Cocos Lagoon from boats than by shore (Study F-1, Job 1).

A comparison was made between the combined day and night catch composition for the top species and families harvested in FY88 and FY92 (Table 7). Harvests of *Naso unicornis*, *Mulloidides flavolineatus*, *Caranx i'e'*, *Kyphosus cinerascens*, *Gerres argyreus*, *Lethrinus harak*, *Liza vaigiensis*, *Naso lituratus*, and *Acanthurus lineatus* were reduced by 73%, 74%, 72%, 63%, 56%, 62%, 54%, 79%, and 72% respectively, with an overall reduction of 60%. *Siganus spinus* increased by 26% in FY92. Family harvests of Acanthuridae, Mullidae, Carangidae, Lethrinidae, Mugilidae, Kyphosidae, and Gerreidae, were reduced by 60%, 52%, 51%, 39%, 41%, 63%, and 56% respectively, with an overall reduction of 38%. Siganidae, Lutjanidae, and Scaridae increased by 12%, 14%, and 91% respectively in FY92.

The seasonal catch of certain juvenile fishes is widely anticipated by local fishermen. The catches of ti'ao and i'e' are usually well represented within the expansion estimates (Tables 4-6). During FY92, pulses of recruiting i'e' occurred in October, 1991 and from June - September, 1992, while ti'ao catches occurred from October - December 1991 and from June - August 1992. I'e' (*Caranx* spp.) and ti'ao (*Mulloidides flavolineatus*) ranked

7th and 8th respectively for day harvest (Table 5), while i'e' ranked 9th for night harvest (Table 6) in FY92.

FY92 marked an exceptional year for mañâhak (ha'tang or *Siganus spinus* and lessor' or *S. argenteus*). The estimated mañâhak catch in East Agana Bay for 1992 was 5.8 mt or 7% of the total finfish harvest (Table 8). The harvest estimates for these fish were determined independently from the 4D program due to the sporadic nature of this fishery. Achenchon (*Pterocaesio* spp.) runs did occur in FY92. Cast nets, drag nets, and gill nets in selected areas accounted for 6% of the total catch or 7.0 mt (Table 8). Unfortunately, catch data were acquired through personal accounts from areas that were inaccessible to DAWR staff.

In addition to finfish, a number of other marine invertebrates were harvested from Guam's reefs. An estimated 2.5 mt (3% of the total annual harvest and 45% of the total invertebrate harvest) of octopus were caught island-wide during FY92. Daytime octopus harvests accounted for 1.5 mt (55% by hooks and gaffs, 33% by spearfishing with snorkel gear, 11% by gill net), while nighttime harvests accounted for 1.0 mt (53% by spearfishing with snorkel gear, 46% by other methods, and 1% by hook and line) in FY92.

The second most caught invertebrate were unidentified mollusks, with an estimated 1.5 mt (2% of the total annual harvest) of the island-wide catch in FY92. Daytime gleaning accounted for 1.5 mt or 100% and there were no unidentified mollusks gleaned at night. The third most caught invertebrate was the spiny lobster, *Panulirus penicillatus*, with an estimated 1.1 mt (1% of the total annual harvest and 19% of the total invertebrate harvest) in FY92. Nighttime spearfishing with snorkel gear accounted for 1.0 mt or 91% of the total spiny lobster catch in FY92. Spearfishing with scuba and snorkel gear accounts for a significant amount of spiny lobster, slipper lobster, and miscellaneous decapods, e.g., *Carpilius maculatus*, harvested at night (based on personal observations by R.F. Meyers, Study F-1, Job 1), but these species were not significantly represented in the inshore survey estimates due to the rarity of snorkel and scuba spearfishing interviews.

Other methods, e.g., gleaning, produced an estimated 2.1 mt or 36% of the invertebrate harvest, especially Mollusca, i.e., bivalves and octopus, with a catch rate of 0.02 kg/ph of fishing effort.

RECOMMENDATION

The establishment of the 4D program has greatly reduced the time needed to compile and analyze Guam's inshore survey data. Because of this, more effort has been spent to continually upgrade our data collection procedures to ensure statistical reliability. Initial aerial observations show that 87.2% of the participants and 87.3% of the gear-units are being surveyed on the shore participation route when compared with the islandwide count. Even though this falls within the estimated 85% from previous aerial surveys (FY63-79), it is recommended that the aerial surveys be continued. The sampling technique has improved since the initiation of the aerial surveys and with further data, an improved quantitative analysis can be done for islandwide inshore fishing effort. Comparisons with aerial participation data should be statistically compared to data obtained during the regular inshore participation in order to update the inshore expansion confidence.

Since the inshore fisheries survey provides information important for management and planning, it is recommended that this job be continued. Due to the inadequacies of the "inshore-catch" survey window, certain methods were not representative of the actual

participation and is reflected in the following catch confidence limits for day: cast net = $\pm 35.1\%$, hooks and gaffs = $\pm 57.2\%$, snorkel spear = $\pm 49.9\%$, and other methods = $\pm 57.0\%$; and night: cast net = $\pm 69.2\%$, scuba spear = $\pm 56.1\%$, and other methods = $\pm 34.2\%$ (methods not listed had confidence limits less than or equal to 24.2%). Methods rarely encountered ($\pm 100.0\%$) during the day included: surround net, scuba spear and drag net; and night: surround net and hooks and gaffs.

The FY92 mañāhak and achenchon season was very successful in comparison with harvests over the last five years. Future improvements rely on the need to upgrade the data collection process in order to improve harvest estimates in the future, i.e., standardized estimate of catch weights and more thorough documentation of island-wide participation. An island-wide harvest estimate would have been possible if the catch interviews were expanded to a greater part of the island.

In addition, the results obtained in the FY92 report can be implemented in the identification and management of fish species that are steadily declining in the overall harvest estimates.

Report prepared by: Todd J. Pitlik
Project Cost: \$81,000

Table 1. Combined estimated inshore participation, effort, and total harvest for all methods during the day and night in FY92.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE**
Hook & Line	34,289	35,447	14,629	159,365	165,046	20,615	20,571	44	0.39 wd
Cast Net	10,596	9,260	7,648	34,475	30,116	26,263	26,263	0	1.12 wd
Gill Net	13,176	6,224	4,425	52,435	24,573	38,242	37,876	366	4.58 wd
Surround Net	271	54	54	1,677	335	382	382	0	1.14 wd
Spear Snorkel	6,128	6,071	2,257	16,100	15,992	10,446	8,089	2,357	1.12 wn
Spear Scuba	260	260	184	277	277	838	838	0	3.03 wn
Drag Net	331	52	52	668	101	537	537	0	6.12 wen
Hooks & Gaffs	698	643	184	3,394	3,129	847	0	847	0.32 wed
Other*	3,854	3,854	2,197	6,027	6,027	2,053	0	2,053	1.82 wen
TOTAL	69,603	61,865	31,630	274,418	245,495	100,223	94,556	5,667	0.41

*Other methods typically includes: gleaning, hand nets, traps, and spears.

**CPUE (kg/gh) summary includes either the greatest weekday (wd) or weeknight (wn) or weekend day (wed), weekend night (wen) values listed in Tables 2 and 3. The greatest CPUE value for hook and line was region 3.

Table 2. Estimated inshore participation, effort, and total harvest for all methods during the day in FY92.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE**
Hook & Line	24,933	25,941	10,898	122,842	127,916	18,699	18,665	34	0.39 wd
Cast Net	10,553	9,217	7,604	34,431	30,072	26,219	26,219	0	1.12 wd
Gill Net	8,534	3,959	2,503	33,639	15,592	26,576	26,306	270	4.58 wd
Surround Net	271	54	54	1,677	335	382	382	0	1.14 wd
Spear Snorkel	2,494	2,437	1,012	5,805	5,697	2,485	1,612	873	0.51 wd
Spear Scuba	0	0	0	0	0	0	0	0	0.0
Drag Net	0	0	0	0	0	0	0	0	0.0
Hooks & Gaffs	698	643	184	3,394	3,129	847	0	847	0.32 wed
Other*	2,514	2,514	980	4,310	4,310	1,594	0	1,594	0.41 wed
TOTAL	49,997	44,765	23,235	206,098	187,051	76,802	73,184	3,618	0.41

*Other methods typically includes: gleaning, hand nets, traps, and spears.

**CPUE (kg/gh) summary includes either the greatest weekday (wd) or weekend day (wed) values. The greatest CPUE value for hook and line was region 3.

Table 3. Estimated inshore participation, effort, and total harvest for all methods during the night in FY92.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE**
Hook & Line	9,356	9,506	3,731	36,523	37,130	1,916	1,905	11	0.06 wen
Cast Net	44	44	44	44	44	44	44	0	0.0
Gill Net	4,642	2,265	1,922	18,796	8,981	11,666	11,570	96	3.06 wn
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	3,634	3,634	1,245	10,295	10,295	7,961	6,477	1,484	1.12 wn
Spear Scuba	260	260	184	277	277	838	838	0	3.03 wn
Drag Net	331	52	52	668	101	537	537	0	6.12 wen
Hooks & Gaffs	0	0	0	0	0	0	0	0	0.0
Other*	1,341	1,341	1,218	1,717	1,717	459	0	459	1.82 wn
TOTAL	19,607	17,101	8,395	68,319	58,544	17,609	15,559	2,050	0.30

*Other methods typically includes: gleaning, hand nets, traps, and spears.

**CPUE (kg/gh) summary includes either the greatest weeknight (wn) or weekend night (wen) values. The greatest CPUE value for hook and line were regions 1 and 2.

Table 4. FY92 combined day and night catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañāhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the day and night catch (94,556 kg). Atulai were not included in the family ranking.

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	47,108.45	49.82	Acanthuridae	9,062.96	9.58
<i>Siganus spinus</i>	6,302.18	6.67	Siganidae	6,920.89	7.32
<i>Naso unicornis</i>	3,478.78	3.68	Scaridae	5,813.29	6.15
<i>Acanthurus triostegus</i>	3,213.60	3.40	Mullidae	4,177.04	4.42
<i>Leptoscarus vaigiensis</i>	2,087.13	2.21	Carangidae	3,751.98	3.97
<i>Caranx i'e'</i>	1,920.42	2.03	Lethrinidae	3,419.11	3.62
<i>Kyphosus cinerascens</i>	1,888.38	2.00	Mugilidae	3,229.79	3.42
<i>Mulloides flavolineatus</i>	1,821.13	1.93	Kyphosidae	1,888.38	2.00
<i>Crenimugil crenilabis</i>	1,657.61	1.80	Lutjanidae	1,411.62	1.49
<i>Gerres argyreus</i>	1,375.82	1.46	Gerreidae	1,375.82	1.46
TOTAL ANNUAL COMBINED CATCH	70,893.50	74.98		41,050.88	43.41

Table 5. FY92 day catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañāhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the day catch (73,184 kg). Atulai were not included in the family ranking.

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	42,175.51	57.63	Siganidae	6,344.60	8.67
<i>Siganus spinus</i>	5,787.47	7.91	Acanthuridae	6,218.32	8.50
<i>Acanthurus triostegus</i>	2,864.91	3.91	Mullidae	2,802.01	3.83
<i>Naso unicornis</i>	2,258.97	3.09	Carangidae	2,672.14	3.65
<i>Leptoscarus vaigiensis</i>	1,931.17	2.64	Scaridae	2,545.11	3.48
<i>Kyphosus cinerascens</i>	1,563.78	2.14	Lethrinidae	1,746.12	2.39
<i>Caranx ie'</i>	1,331.33	1.82	Kyphosidae	1,563.78	2.14
<i>Mulloides ti'ao</i>	1,104.80	1.51	Mugilidae	1,249.36	1.71
<i>Gerres argyreus</i>	1,045.65	1.43	Lutjanidae	1,027.49	1.40
<i>Mulloides flavolineatus</i>	1,021.98	1.40	Gerreidae	1,045.65	1.43
TOTAL ANNUAL COMBINED CATCH	61,085.57	83.47		27,214.58	37.19

Table 6. FY92 night catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm) and *Mulloidides flavolineatus* (ti'ao ≤ 100mm), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the day and night catch (23,421 kg). Atulai were not included in the family ranking.

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	4,932.94	21.06	Scaridae	3,268.18	13.95
<i>Scarus rubroviolaceus</i>	2,854.57	12.19	Acanthuridae	2,844.64	12.15
<i>Naso unicornis</i>	1,219.81	5.21	Mugilidae	1,980.43	8.46
<i>Crenimugil crenilabis</i>	1,009.44	4.31	Lethrinidae	1,672.99	7.14
<i>Leiognathus equulus</i>	914.14	3.90	Mullidae	1,375.03	5.87
<i>Lethrinus obsoletus</i>	881.05	3.76	Carangidae	1,079.84	4.61
<i>Mulloidides flavolineatus</i>	799.15	3.41	Leiognathidae	914.14	3.90
<i>Liza vaigiensis</i>	787.98	3.36	Carcharhinidae	542.62	2.32
<i>Caranx i'e'</i>	589.09	2.52	Gerreidae	330.17	1.41
<i>Carcharhinus melanopterus</i>	542.62	2.32	Kyphosidae	324.60	1.39
TOTAL ANNUAL COMBINED CATCH	14,530.79	62.04		14,332.64	61.20

Table 7. Comparison of the combined day and night catch composition for the top species and families of finfish harvested in FY88 and FY92. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloidides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañâhak), are listed separately from the intermediate to adult size classes. Atulai were not included in the family ranking.

SPECIES	Harvest (kg)			FAMILY	Harvest (kg)		
	FY88	FY92	% Δ		FY88	FY92	% Δ
<i>Naso unicornis</i>	12,914.20	3,478.78	↓ 73	Acanthuridae	22,453.05	9,062.96	↓ 60
<i>Mulloidides flavolineatus</i>	7,082.65	1,821.13	↓ 74	Mullidae	8,716.71	4,177.04	↓ 52
<i>Caranx i'e'</i>	6,890.35	1,920.42	↓ 72	Carangidae	7,729.63	3,751.98	↓ 51
<i>Kyphosus cinerascens</i>	5,069.66	1,888.38	↓ 63	Siganidae	6,104.52	6,920.89	12 ↑
<i>Siganus spinus</i>	4,767.67	6,302.18	24 ↑	Lethrinidae	5,578.27	3,419.11	↓ 39
<i>Gerres argyreus</i>	3,141.71	1,375.82	↓ 56	Mugilidae	5,448.00	3,229.79	↓ 41
<i>Lethrinus harak</i>	3,126.15	1,190.67	↓ 62	Kyphosidae	5,069.66	1,888.38	↓ 63
<i>Liza vaigiensis</i>	2,945.15	1,343.33	↓ 54	Gerreidae	3,141.71	1,375.82	↓ 56
<i>Naso lituratus</i>	2,743.30	585.70	↓ 79	Lutjanidae	1,207.23	1,411.62	14 ↑
<i>Acanthurus lineatus</i>	1,875.67	532.55	↓ 72	Scaridae	498.40	5,813.29	91 ↑
TOTAL ANNUAL COMBINED CATCH	50,556.51	20,438.96	↓ 60		65,947.18	41,050.88	↓ 38

% Δ reduction (↓) or % Δ increase (↑) of species and family totals (kg) from FY88-92.

Table 8. FY92 maññhak and achemsom harvest during May and June. Catch data (kg) was obtained from the following locations for maññhak: East Agana Bay; and achenchon: East Agana Bay, Luminao Reef, Merizo, Piti Channel, and Uruno Beach.

Maññhak

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	CPUE*
Cast Net	187.0	137.0	77.0	1,162.3	870.0	5,708.8	6.56
Surround Net	19.0	3.0	3.0	146.0	23.5	115.4	4.91
TOTAL	206.0	140.0	80.0	1,308.3	893.5	5,824.2	6.52

Achemsom

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	CPT**
Cast Net and Surround Net	***	***	25.0	***	***	6,981.3	279.25
TOTAL	***	***	25.0	***	***	6,981.3	279.25

*CPUE summary is listed in kg/gh.

**CPT summary is listed in kg/trip.

***Insufficient participation and catch interview data to report.

Table 9. FY92 day and night catch composition for the top ten species of finfish harvested by hook and line method. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the (18,665 kg) and night (1,905 kg) hook and line catch.

DAY SPECIES	Harvest		NIGHT SPECIES	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	9,800.80	52.51	<i>Caranx ignobilis</i>	262.65	13.79
<i>Naso unicornis</i>	1,994.55	10.69	<i>Selar crumenophthalmus</i>	158.56	8.32
<i>Caranx i'e'</i>	1,089.72	5.84	<i>Decapterus macrosoma</i>	157.59	8.27
<i>Kyphosus cinerascens</i>	1,228.34	6.58	<i>Sphyraena barracuda</i>	141.83	7.45
<i>Lethrinus harak</i>	553.73	2.97	<i>Lethrinus obsoletus</i>	127.21	6.68
<i>Lethrinus olivaceus</i>	379.35	2.03	<i>Lethrinus harak</i>	120.50	6.33
<i>Acanthurus xanthopterus</i>	331.99	1.78	<i>Sphyraena qenie</i>	116.54	6.12
<i>Aprion virescens</i>	328.36	1.76	<i>Lutjanus argentimaculatus</i>	81.42	4.27
<i>Liza vaigiensis</i>	293.19	1.57	<i>Carcharhinus melanopterus</i>	56.57	2.97
<i>Epinephelus merra</i>	277.82	1.49	<i>Arothron manilensis</i>	55.12	2.89
Total Top Ten Hook & Line Catch	16,277.85	87.21		1,277.99	67.09
Total Combined Hook & Line Catch	17,555.84	85.35			

Table 10. FY92 day and night catch composition for the top ten species of finfish harvested by gill net method. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200 mm), *Mulloides flavolineatus* (ti'ao ≤ 100 mm), and *Siganus spinus* (mañâhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the day (26,306 kg) and night (11,570 kg) gill net catch.

DAY SPECIES	Harvest		NIGHT SPECIES	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	15,532.54	59.05	<i>Selar crumenophthalmus</i>	4,774.37	41.27
<i>Leptoscarus vaigiensis</i>	1,931.17	7.34	<i>Crenimugil crenilabis</i>	1,004.85	8.68
<i>Gerres argyreus</i>	1,028.36	3.91	<i>Leiognathus equulus</i>	895.67	7.74
<i>Mulloides flavolineatus</i>	920.87	3.50	<i>Liza vaigiensis</i>	787.58	6.81
<i>Acanthurus triostegus</i>	838.08	3.19	<i>Lethrinus obsoletus</i>	733.13	6.34
<i>Caranx ignobilis</i>	514.78	1.96	<i>Mulloides flavolineatus</i>	620.67	5.36
<i>Crenimugil crenilabis</i>	436.48	1.66	<i>Carcharhinus melanopterus</i>	473.19	4.09
<i>Lethrinus harak</i>	407.44	1.55	<i>Caranx i'e'</i>	357.23	3.09
<i>Siganus spinus</i>	314.17	1.19	<i>Gerres argyreus</i>	330.17	2.85
<i>Leiognathus equulus</i>	291.29	1.11	<i>Kyphosus cinerascens</i>	310.86	2.69
Total Top Ten Gill Net Catch	22,215.18	84.45		10,287.72	88.92
Total Combined Gill Net Catch	32,502.90	85.81			

Table 11. FY92 day and night catch composition for the top ten species of finfish harvested by spear snorkel method. Finfish harvest percentages were derived from the total day (1,612 kg) and night (6,477 kg) spear snorkel catch.

DAY SPECIES	Harvest		NIGHT SPECIES	Harvest	
	kg	%		kg	%
<i>Trachinotus blochii</i>	400.03	24.82	<i>Scarus rubroviolaceus</i>	2,854.57	44.07
<i>Ctenochaetus striatus</i>	168.01	10.42	<i>Naso unicornis</i>	1,136.54	17.55
<i>Siganus punctatus</i>	163.21	10.12	<i>Acanthurus lineatus</i>	475.76	7.35
<i>Diodon hystrix</i>	145.45	9.02	<i>Siganus spinus</i>	412.86	6.37
<i>Epinephelus merra</i>	119.21	7.40	<i>Monotaxis grandoculus</i>	399.11	6.16
<i>Scarus sordidus</i>	92.65	5.75	<i>Acanthurus xanthopterus</i>	330.39	5.10
<i>Naso lituratus</i>	75.21	4.67	<i>Acanthurus triostegus</i>	269.33	4.16
<i>Monodactylus argenteus</i>	59.04	3.66	<i>Naso lituratus</i>	211.45	3.26
<i>Acanthurus lineatus</i>	42.40	2.63	<i>Lutjanus fulvus</i>	121.58	1.88
<i>Siganus spinus</i>	40.00	2.48	<i>Acanthurus guttatus</i>	63.43	0.98
Total Top Ten Spear Snorkel Catch	1,305.21	80.97		6,275.02	96.88
Total Combined Spear Snorkel Catch	7,580.23	93.71			

APPENDIX 1

INSHORE AERIAL SURVEY

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

A total of 16 "inshore aerial" surveys were conducted in FY92 for a total of 571 persons and 461 gear units. Hook and line was the most frequently encountered method with 296 persons and 286 gear units. A ratio of participants / method observed in areas outside the inshore participation route to the total number for all methods surveyed during the "inshore aerial" were calculated as variables (P_2 values) for the inshore expansion. The values ranged from 25% for weekday snorkel spearfishing to 100% for rare and night-practiced methods, e.g., surround net, SCUBA spearfishing, hook and gaff, drag net, and other methods.

Incidental biological sightings resulted in a total of 73 turtles, 80 dolphins, 18 sharks, 2 eagle rays and sting rays, and 1 manta ray for FY92.

BACKGROUND

Inshore fishing surveys have been conducted by the Division of Aquatics and Wildlife Resources (DAWR) since the early 1960's to monitor and collect a long-term database on the total fishing effort and catch from Guam's reefs. The "inshore-catch" and "inshore-participation" surveys were developed to collect catch and effort data in nearshore areas easily accessible by motor vehicle. In addition, the "inshore-aerial" survey was established in the early 60's and reinstated in FY90 to survey effort in areas that could not be easily accessed by a vehicle.

PROCEDURES

"Inshore-aerial" surveys were conducted twice monthly on regularly scheduled participation days (one weekday / weekend). Start times are moved up in one hour intervals for each subsequent survey (0800-1200h), then repeated after reaching 1200h. Visual observations of areas not covered in the "inshore-participation" survey (Fig. 1 locations: 18, 22, 27, 28, 35→39, 44→50, 54, 55, 58, 59, 70, and 73→92) included fishing effort data. The first scheduled weekday and weekend participation survey dates of each month were selected to allow rescheduling in the event of poor weather conditions.

Each survey started in area 11 and proceeded in a clockwise direction all the way around the island to area 12 (Fig. 1). The seaward flight distance from the reef margin was 200-300m with an altitude of 170-200m. The aerial itinerary also included a semi-circular flight pattern within Cocos Lagoon and Apra Harbor. In addition, the pilot was instructed to circle over reef flat areas when it was difficult to observe or determine activity.

The aerial survey observations were sorted by method and type day (weekday / weekend). A ratio of the persons / method observed in areas outside the inshore participation route were compared to the total number of persons / method observations for the island for

each type day. The resultant P₂ values provided variables (%) that could be used to expand inshore participation values to island-wide participation values.

Other biological data collected, included incidental observations of marine mammals, turtles, sharks, and rays at or near the surface of various reef zones, e.g., Pati Point and the fore reef slope, along the aerial survey route.

The FY92 inshore harvest estimates were statistically expanded by a computer software package for Macintosh known as the 4th Dimension database program (4D). The 4D program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2) to compile and expand inshore survey data for the fiscal year.

RESULTS

The most frequently encountered methods included hook and line, cast net, gill net, surround net, snorkel spear, and other methods, while hooks and gaffs, SCUBA spear, and drag net methods were less common. Ratio frequencies were highest (100%) for the least common methods, which were due to the rarity of their use during the day, e.g., SCUBA spear and drag net are primarily night methods. Hook and line, cast net, gill net, surround net, snorkel spear, SCUBA spear, hooks and gaffs, and other methods (weekday and weekend days respectively) had P₂ values (Table 1) listed as percentages: (99 / 89), (85 / 72), (94 / 83), (68 / 100), (25 / 72), (50 / 100), (100 / 100), and (50 / 100), respectively for FY92.

Cancellations due to poor weather conditions, was a problem in FY92. Nine cancellations (38%) occurred on the following weekday (WD) and weekend (WE) survey dates: WD (10/24/91, 11/7/91, 3/3/92, 5/26/92, and 9/9/92); and WE (11/23/91, 12/7/91, 1/11/92, and 5/30/92).

The greatest number of people fishing in participation areas during the aerial survey used hook and line on weekdays and weekends for a total of 199 and 194 persons and gear-units respectively, while hook and line was also the most frequently used method in aerial areas for a total of 24 and 20 persons and gear units respectively for FY92 (Table 2).

Dolphins topped the list of the most frequently sighted marine animals during the aerial surveys with 80 sightings. The greatest monthly total of 40 dolphin sightings occurred in August (Table 3). Turtles, sharks, and ray sightings ranked 2nd, 3rd, and 5th, respectively with annual totals (Table 3). The greatest monthly total of turtles were sighted in August with 15 and sharks in March and July with 7. In addition, 2 eagle rays, 2 stingrays, and 1 manta ray were sighted in FY92 (Table 3).

Report prepared by: Todd J. Pitlik
Flight Cost: \$9,500

Table 1. P_2 values from aerial surveys in FY92. Ratios originated from method sightings within aerial locations : participation locations (Fig. 2). Methods are listed as follows: Hook and Line (HL), Cast Net (CN), Gill Net (GN), Surround Net (SN), Spear Snorkel (SpSn), Spear SCUBA (SpSc), Hooks and Gaffs (HG), Drag Net (DN), and Other Methods (OM).

Ratios	HL	CN	GN	SN	SpSn	SpSc	HG	DN	OM
Weekday	1/72	4/23	2/30	6/13	3/1	2/2	0/1	0/0	3/3
Weekend	24/199	15/38	10/49	0/17	10/26	0/14	0/1	0/0	0/2
WD Ratio	1/73	4/7	2/32	6/19	3/4	2/4	0/1	0/0	3/6
WE Ratio	24/223	15/53	10/59	0/17	10/36	0/14	0/1	0/0	0/2
WD P_2	99	85	94	68	25	50	100	100	50
WE P_2	89	72	83	100	72	100	100	100	100

Table 2. Total number of people and gear units observed during the aerial surveys in FY92. Abbreviations are listed for the following day types: WD (weekdays) and WE (weekends). Method abbreviations are listed in Table 1.

Methods	Within Par Route				Outside Par Route			
	Persons		Gears		Persons		Gears	
	WD	WE	WD	WE	WD	WE	WD	WE
HL	72	199	71	194	1	24	1	20
CN	23	38	21	30	4	15	3	12
GN	30	49	14	22	2	10	1	4
SN	13	17	1	3	6	0	1	0
SpSn	1	26	1	26	3	10	3	10
SpSc	2	14	2	9	2	0	2	0
HG	1	1	1	1	0	0	0	0
OM	3	2	3	2	3	0	3	0
Total	145	346	114	287	21	59	14	46

Table 3. Number of turtle, dolphin, shark, and ray sightings by aerial surveys around Guam in FY92.

Month	Turtle	Dolphin	Shark	Eagle Ray	Sting Ray	Manta Ray
Oct	1	0	2	0	0	0
Nov	0	0	0	0	0	0
Dec	1	0	0	0	0	0
Jan	3	0	0	0	0	0
Feb	9	0	0	0	1	0
Mar	3	30	7	2	1	0
Apr	13	0	1	0	0	0
May	0	0	0	0	0	0
June	6	10	1	0	0	0
July	12	0	7	0	0	1
Aug	15	40	0	0	0	0
Sep	5	0	0	0	0	0
Total	73	80	18	2	2	1

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29
SUB-PROJECT NO.: F-1
STUDY NO.: 2
JOB NO.: 1

STUDY 2: Computerized Data Manipulation of Guam's Fisheries Data

JOB TITLE: Fisheries Data Processing

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

During FY92 the data processing project coordinator resigned. Present data files are incomplete. Up dating of files will be done when a replacement is hired.

BACKGROUND

Guam's Division of Aquatic and Wildlife Resources (DAWR) has been collecting fisheries information over the past 24 years (with only the last fifteen years of data being reliable) and, as a result, an enormous amount of fisheries management data has been accumulated. Computers have been used over the past eight years by DAWR to store and analyze this data. DAWR personnel, working closely with the National Marine Fisheries Service, have developed and purchased programs for analyzing the Division's offshore and inshore fisheries survey data.

In FY83, a program entitled the Guam Offshore Expansion System (GOES) was developed based on the current practices of offshore data analysis and, in FY85, a Guam Inshore Expansion System (GIES) was completed and tested for errors (this program underwent modifications in FY90 to take advantage of the storage capability and speed of computers that are currently available). Since this time, all data collected for the offshore and inshore fisheries surveys have been analyzed through the use of these two programs.

Job 3, Fisheries Data Processing, has been jointly funded by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Western Pacific Regional Fisheries Management Council.

OBJECTIVES

1. Computerize the DAWR's offshore and inshore marine fisheries data and transfer the finalized fisheries data files and reports to NMFS personnel in Honolulu, Hawaii for regional application.
2. Provide technical assistance to DAWR staff biologists in the form of efficient statistical analysis and report generation.

PROCEDURES

Guam's offshore fisheries survey data are analyzed by a system of computer programs known as the GOES. This programming package is a 5-step system that summarizes, sorts, and statistically expands the survey data to produce monthly and annual catch, effort, and species composition estimates. Two proportionality constants and a "total participation boat count" are calculated and manually entered into the expansion module by the user. Reports are generated by the GOES that give a breakdown of the estimated offshore harvest by gear type on a monthly and annual basis. Also, an estimated harvest by species is generated for each gear type with a corresponding percentage of the total catch for that gear type.

Guam's inshore fisheries survey data are analyzed by a programming package known as the GIES. The original GIES was a 4-step system that relies on two sets of survey data to determine an annual inshore estimated harvest. This program was modified this fiscal year so that the program can take advantage of the new computer technology in data storage and processing speed. The two sets of data are referred to as "inshore-participation" and "inshore-catch". "Inshore-participation" data consists of fishermen and gear counts obtained by biological aides when driving around the island and making observations on fishing activity within the fringing reef. "Inshore-catch" data are obtained by fishermen-intercept interviews that usually occur within a predetermined survey region. These data consist of a total catch and catch by species for each interview. Because of the apparent differences in participation and catch-per-unit-effort (CPUE) of the various gear types between daytime and nighttime fishing, a fisheries survey is conducted during each of these two time periods and the data are analyzed separately. Also, data are collected during the seasonal harvest of juvenile rabbitfish (*Siganus sp.*) and bigeye scad (*Selar crumenophthalmus*), but, because of the dissimilarities between the seasonal fisheries and the routine inshore fisheries, the two are analyzed separately.

RECOMMENDATION

Data processing is a valuable asset to the many research projects currently undertaken at DAWR. The need for data storage and retrieval, data analysis, programming and report generation has increased greatly since the installation of a computer system. Staff must be hired to reactivate this program.

Report prepared by: Gerald W. Davis

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO: F-1

STUDY NO.: 3

JOB NO.: 2

STUDY 3. Studies of Guam's recreationally-important Fish

JOB TITLE: Biology of *Mulloides flavolineatus*.

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

This job was completed during FY91 with a final report given in the FY91 annual report.

Report prepared by Robert F. Myers

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: FW-2R-29

SUB-PROJECT NO: F-1

STUDY NO: 3

JOB NO: 3

STUDY 3: Studies of Guam's Recreationally-Important Fish

JOB TITLE: Biology of *Lethrinus harak*

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Tabled since FY85, the project to study the biology of the Emperor Snapper, *Lethrinus harak*, resumed at the end of FY92 with the assignment of a new project coordinator, and has been expanded to include another emperor species, *Lethrinus obsoletus*. Both emperor species are considered to be recreationally-important and share much in common in terms of their biology and susceptibility to current fishing pressure. Data collected in FY93 and beyond will be compiled with FY85 data to yield more comprehensive progress reports in the upcoming years. Based on the findings of the study, recommendations may be made for the management and preservation of stocks of *L. harak* and *L. obsoletus* in Guam's waters.

BACKGROUND

The family Lethrinidae (emperors) are close relatives of snappers but differ primarily by having a maxillary completely hidden by a bare or near-bare preopercle and conical or molariform teeth on the sides of the jaws. Lethrinids also have fairly thick lips, canine teeth towards the front of the jaws, a continuous dorsal fin with X spines and 9 to 10 rays, and an anal fin with III spines and 8 to 10 rays (Myers 1991).

Lethrinus harak, commonly known as the Blackspot or Thumbprint Emperor, inhabits mangroves, coral rubble, shallow sandy lagoons, channels and seagrass areas adjacent to coral reefs. It feeds on crustaceans, molluscs, polychaetes, echinoderms and small fishes, and grows to about 30 cm total length. *L. harak* have been reported to spawn in large aggregations year-round during the first five days of the lunar month in lagoons of Belau (Carpenter & Allen 1989).

Lethrinus obsoletus, commonly known as the Orange-striped Emperor, is also found in seagrass beds and sand and rubble areas of lagoons and reefs. Much like *L. harak*, *L. obsoletus* feeds primarily on crustaceans, molluscs and echinoderms, and grows to about 30 cm in total length. In Belau, spawning is reported to occur at the outer reef edge during the first five days of the lunar month between November through April (Carpenter & Allen 1989). *L. harak* has been observed by fishermen to burrow in the sand (Schroeder, 1980) which may serve as a means of escaping their predators and drag nets.

OBJECTIVES

The primary objective of the study will be to continue collection and analysis of data on the natural history and biology of two common species of emperors, *Lethrinus harak* and *Lethrinus obsoletus*, which could be useful in the planning of a management strategy.

METHODS

The study of *L. harak* and *L. obsoletus* will include the following parameters: size distribution, sex ratio, spawning seasonality, lunar occurrence of spawning activity, fecundity and reproductive contribution among the various size classes, and historic harvest analysis.

Tag and release of *L. harak* and *L. obsoletus* will be conducted on a biweekly basis as weather, sea conditions and manpower permit. Upon capture, the fish will be measured (fork length), tagged and then released. Fish that have swallowed the hook will be measured but not tagged or released since they will most likely perish during hook removal. A DAWR press release will be issued requesting that fishermen provide the division with the length or weight, location, catch method and capture date of all tagged fish. The occurrence of local migrations if any, of *L. harak* and *L. obsoletus* may be determined based on tag recovery information.

Histological examinations of gonad samples among the various size classes will be conducted to determine gamete development and fecundity. Gonad sampling dates and lunar phase will be noted to determine if *L. harak* and *L. obsoletus* are indeed serial spawners following a lunar cycle. Histological data collected in FY85 will be supplemented with information gathered in FY'93 and beyond.

Computer processing of inshore catch records for *L. harak* and *L. obsoletus* for FY85 and beyond will provide for a historic analysis of the exploitation trends of the species over the years.

RECOMMENDATIONS

This project will provide valuable information essential for the future management of Guam's stocks of *L. harak* and *L. obsoletus* and should be continued with the following recommendations for FY93:

1. Hire additional fisheries staff to facilitate regular sampling and tagging trips.
2. Purchase necessary fishing and laboratory equipment to conduct tagging, sampling and histological procedures.
3. Issue press release and post information of procedures for recovering tagged fish.
4. Complete analysis of FY85 *L. harak* data.
5. Begin sampling for fecundity and reproductive contribution.

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Report prepared by: Andrew A. Torres

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO: F-1

STUDY NO.: 4

JOB NO.: 1

STUDY 4. Establishment of a Marine Sanctuary

JOB TITLE: Establishment of a Marine Conservation Area

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

This project was inactive during FY92 due to lack of staff.

RECOMMENDATIONS

This project should be reactivated in FY93 or as soon as staff become available.

Report prepared by Robert F. Myers

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO: F-2

STUDY NO.: 1

JOB NO.: 1

STUDY 1. Management of Guam's Freshwater Fisheries Resources

JOB TITLE: Fisheries Studies in Fena Lake

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

This project was inactive during FY92 due to lack of staff.

RECOMMENDATIONS

This project should be reactivated when staff become available.

Report prepared by Robert F. Myers

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO: F-2

STUDY NO.: 1

JOB NO.: 2

STUDY 1. Management of Guam's Freshwater Fisheries Resources

JOB TITLE: Biological Survey of the Ugum River

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

This project was inactive during FY92 due to lack of staff.

RECOMMENDATIONS

This project should be reactivated when staff become available.

Report prepared by Robert F. Myers

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-2-D
SEGMENT: 6

PROJECT TITLE: Marine Fish Habitat Improvement and Aggregating Devices

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Fish Aggregating Devices

Four of the five fish aggregating devices (FADs) deployed in April, 1990, and later lost during FY90 and FY91, were replaced in March, 1992. The fifth FAD at the Ritidian site was not replaced, due to the existence of a NOAA weather buoy within two miles of the original FAD site. The weather buoy fortuitously functioned as a fish aggregating device during its time on station. The weather buoy has since been relocated approximately 40 miles away and will necessitate the reinstallation of a FAD at the Ritidian site.

All four FY92 sites (Figure 1; FADs 1-4) were deployed on March 27, 1992. By mid-August, two of the FADs, Facpi Pt. (FAD #1) and Cocos Island. (FAD #2) were reported missing. The buoys were lost during a period of relatively calm weather (prior to Typhoon Omar) and were not recovered. It is speculated that the short time on station of less than five months (average life span: 8 months) may have been caused by the use of two separate blocks in the anchoring system and the fall pattern of the blocks as they settled during deployment, combined with the release of the anchor blocks with a slack line between the buoy and anchors when proper deployment requires that the entire mooring assembly be played out and pulled taut prior to release of the anchor blocks.

The Division of Aquatic and Wildlife Resources (DAWR) applied for a Nationwide Permit 4 (NWP4 - Fish Harvesting Devices), as recommended by the Army Corps of Engineers (ACOE), to replace the General Permit (PODCO-O GP 82-3) that expired on April 14, 1992. The NWP4 is valid for only a two-year period, but takes much less time to process and modify. The NWP4 will authorize the maintenance and replacement of FADs currently designated by DAWR for continued operation. Three proposed FAD sites off the eastern windward coast of Guam - Pati Pt., Fadian Pt. and Asiga Pt. (surveyed in FY91) - were also included in the NWP4 application (Figure 1; FADs 5-7).

Supplies and materials necessary for ten fishing buoy systems have been ordered and are expected to arrive by early FY93. The forthcoming equipment will enable the replacement of FADs 1 and 2 lost in August as well as provide for the deployment of systems for the Ritidian site and the three proposed eastern sites. The remaining inventory will serve as replacement material for systems that are lost over the course of FY93 and beyond.

The coordinator for the FAD project resigned in February '92 and a replacement was not hired until August '92. During the interim, routine FAD maintenance and monitoring, aside from occasional shore-based evening checks for buoy light operation, was not conducted. With the assignment of a new coordinator for the project, plans are being made to conduct biweekly on-site service checks as weather, time and manpower permit.

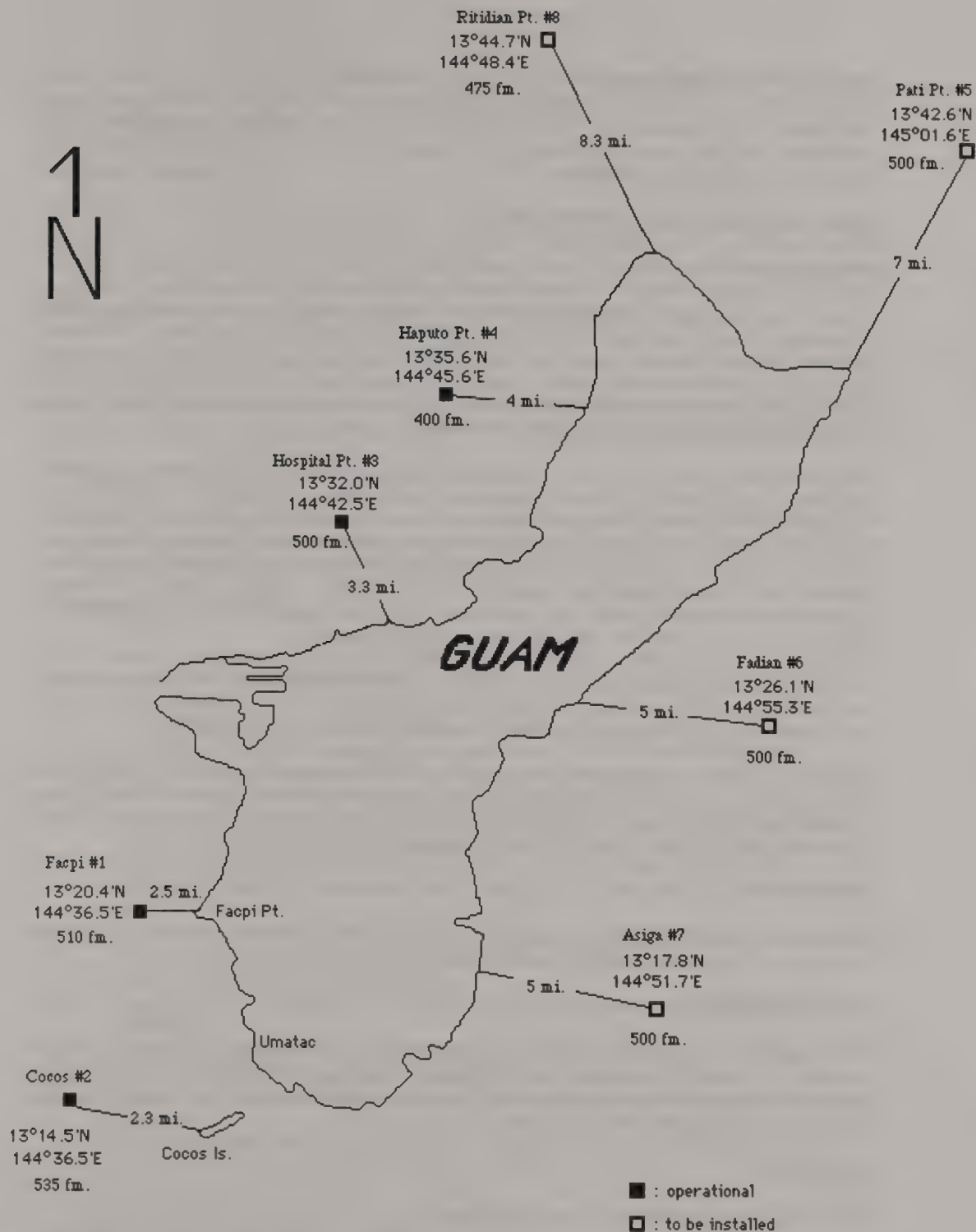


Figure 1. FAD sites

Shallow Water Moorings

No activity was recorded in FY92 for the shallow water mooring project due to the resignation of the project coordinator in February '92. A new coordinator has been assigned to reactivate the project in FY93.

FISH AGGREGATING DEVICES

BACKGROUND

Guam's most productive trolling occurs in the vicinity of offshore banks such as White Tuna Bank, Santa Rosa Reef, Galvez Bank, Eleven-mile Bank and Rota Bank. However, because of their distances from the Island's marinas and boat launching ramps, these fishing areas are not always safely accessible for many boats, especially during inclement weather. Furthermore, the amount of fuel consumed to reach the popular fishing banks usually makes the fishing trip an expensive outing.

Fish aggregating devices (FADs) are effective in attracting and holding pelagic migratory fish such as yellowfin (*Thunnus albacares*) and bonita (*Katsuwonus pelamis*) tuna, kawakawa (*Euthynnus affinis*), wahoo (*Acanthocybium solandri*), mahi mahi (*Coryphaena hippurus*) and blue marlin (*Makaira nigricans*), in offshore coastal waters. Although the FADs will increase the harvest of Pacific migratory fishes in Guam's waters, the additional pressure will have no significant impact on the fish stocks. Guam's harvest will remain small-scale and only represent an extremely small percentage of the total amount of migratory fish that pass through the island's offshore waters.

FADs have no adverse impact on non-migratory pelagic or demersal fish, fauna, wildlife and other natural environmental values, and conform to United States Coast Guard requirements for marking, lighting and standardization of aids to navigation.

Installation of FADs in Guam's offshore coastal waters began in 1979, initially with funding from the Saltonstall-Kennedy Act through the Pacific Tuna Development Foundation. The Guam FAD project is currently being continued as part of Dingle-Johnson/Wallop-Breaux Sport Fish Restoration program.

OBJECTIVE

DAWR's objective is to develop, deploy and maintain fish aggregation devices and shallow water moorings in the nearshore waters off Guam.

PROCEDURES

Procedures for construction and deployment of FADs during FY92 followed methods recorded in the FY91 annual report. Routine monitoring and maintenance of the FADs were not conducted due the resignations of the project coordinator in March and three other fisheries staff members later in the year.

RESULTS

Site Modifications and New Locations

The sites of FADs 1-4 are listed in Figure 1 and have not been modified since the March 1992 deployments. The proposed eastern windward sites for FADs 5-7 (Figure 1). The relocation of the NOAA weather buoy from the Ritidian site will necessitate the

reinstallation of a FAD at the Ritidian site, which will be designated as FAD #8. A permit modification of the NWP4 will be submitted after issuance by ACOE to request inclusion of the Ritidian site (FAD #8) once again.

Redeployments

The Facpi Pt., Cocos Island, Haputo Pt. and Hospital Pt. buoys (FADs 1-4) were redeployed on March 27, 1992. It was noted during actual deployment procedures that the Facpi Pt. and Cocos Island FADs were both released under conditions of slack line which may have contributed to the relatively short time on station. Evidence to support this theory could not be obtained since neither of the buoys were recovered.

FADs on Station

The Facpi Pt. and Cocos Is. buoys were lost only several weeks apart sometime in early to mid-August, 1992. Time on station for these two FADs was approximately five months.

Fishing Activity

Information on fishing activity and success near FADs gathered as part of offshore creel surveys during FY92 has not been compiled or analyzed due to the resignation of the project coordinator and data analysis specialist.

RECOMMENDATIONS

FADs remain quite popular with local fishermen and are most noticed when the systems are no longer on site. The project should be continued with the following recommendations:

1. Obtain NWP4 from ACOE to replace expired General Permit.
2. Modify the NWP4 to include the reinstallation of a FAD at the Ritidian site.
3. Hire additional fisheries staff to facilitate regular maintenance checks of FADs and enable compilation and analysis of FAD fishing data.
4. Acquire a sufficient inventory of FAD equipment and materials to allow for routine maintenance and the immediate replacement of lost FADs.
5. Redesign anchoring system to a single block system and ensure anchor release during deployment is conducted only while the mooring line and chains are kept taut.
6. Investigate methods for the rapid recovery of lost systems as a means to determining where mooring system failure is occurring.
7. Install a radar reflector on each FAD.
8. Attach a counterweight on the buoys to maintain a more upright position when in the water.
9. Identify an alternate FAD deployment vessel since the current deployment vessel, the M.V. Ocean Dolphin, has announced plans to relocate elsewhere.
10. Prepare an updated cost analysis for FAD construction, deployment and maintenance.
11. Place permanent markings on the buoy to facilitate return of the buoy if lost.

Report prepared by: Andrew A. Torres

JOB PROGRESS REPORT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D
SEGMENT.: 7

JOB TITLE: Construction of Boating Access Facilities

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Construction of the Merizo Pier was completed during FY92. Official opening of the pier is pending installation of the proper project signage.

BACKGROUND

The project history and progress can be researched through the annual reports submitted previously on this project.

OBJECTIVE

To increase boating accessibility to fishing grounds through the creation of safe, strategically located boat launching facilities.

RESULTS

During FY92 the initiation and completion of the construction of Merizo Pier was achieved. Guam also experienced a direct hit by Typhoon Omar in August, which did not damage the pier in any noticeable way. Although, the pier has not been officially opened pending installation of the required signage, the pier is already receiving continuous use by boaters and fisherman. Now that the completion of this project is foreseen, progress toward the initiation of other projects can proceed.

RECOMMENDATIONS

A number of potential launching facility sites have been identified and these should be pursued. During FY92 the project coordinator resigned and it is essential for this project to proceed that new staff to be hired.

Report Prepared by: Gerald W. Davis

JOB PROGRESS REPORT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D
SEGMENT: 2

JOB TITLE: Development of Inshore Fishing Access Facilities

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

During FY92, the reef fishing platform design was ninety percent completed. The final plans and specifications are to be completed by the end of 1992.

BACKGROUND

The historical, traditional use and design of fishing platforms has been reviewed in previous fiscal year reports (Kruckenberg, 1989; Kruckenberg, 1990; Kruckenberg, 1991). Because inshore fishing continues to be a popular activity, there is a real need to provide greater accessibility to inshore fishing areas and improved safety in areas that are typically unsafe.

OBJECTIVE

To plan, design and construct inshore fishing access facilities (reef flat platforms and cliff platforms) on the windward coast of Guam and research the possibilities of alternate sites on the leeward coast.

PROCEDURE

The Division of Aquatic and Wildlife Resources (DAWR) has been actively pursuing the planning, design, site selection, environmental review and construction of the reef flat fishing platforms for 4 years (Kruckenberg, 1989, 1990 & 1991). The primary focus during FY92 was to work directly with the engineering firm contracted to complete the plans and construction documents.

RESULTS

The design and engineering plans for the fishing platforms are ninety percent done. An initial set of drawings has been completed and reviewed by the office staff. Modifications will be made to the design to make the fishing platform safer and more practical. The final plans and specifications for construction are to be completed by the end of December 1992.

Ten sites are actively being considered for fishing platforms around Guam: (1) Pago Bay, (2) Ylig Bay, (3) Togcha Bay, (4) Talofoto Bay, (5) Agfayan Bay, (6) Ajayan Bay, (7) Toguan Bay, (8) Togcha Beach Cut, (9) Tepungan Channel and (10) Asan Bay. Specific site information is available upon request.

DISCUSSION

Once the design plans have been completed, environmental clearances for site approval and construction methods will be initiated. Clearances will be required from the Federal Aid Program, the Territorial Seashore Protection Commission, the Guam Environmental Protection Agency (Environmental Protection Plan, Water Quality (404, 401)), the Coastal Zone Management Program and the U.S. Army Corps of Engineers. The clearances will take most of FY93 if not longer to complete. Once clearances have been awarded the project will be placed out on bid for the fabrication and installation of the platforms.

RECOMMENDATIONS

This program has valuable traditional fishing application for Guam while providing a safety factor and enhancing fishing opportunities. We therefore recommend that this job continue to develop a fishing platform program for Guam

LITERATURE CITED

- Kruckenber, Wayne L. 1991. Inshore Fishing Access Facilities. Project F-2-D-9 Annual Report Fiscal Year 1991. Aquatic and Wildlife Resources, Department of Agriculture, Government of Guam.
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Report prepared by: Wayne L. Kruckenber

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

JOB TITLE: Giant Clam Transplantation

PERIOD COVERED: October 1, 1991 to September 30, 1992.

SUMMARY

Mature giant clams (*Tridacna derasa*) transplanted to sites in Sasa Bay and Jade Shoals during FY 89-90 are periodically monitored. An attempt is made to measure each clam once a year and check for signs of parasitism, predation, or poaching.

BACKGROUND

Species of giant clams (genus *Tridacna*) are an important traditional food as well as a valuable export commodity for Asian food markets and the worldwide aquarium trade (Copeland and Lucas, 1988). During the past 3 decades, giant clam stocks on most coral reefs have become seriously depleted. Three species are native to Guam: *Tridacna maxima*, *T. squamosa*, and *Hippopus hippopus*. The largest species, *T. gigas* is known from Guam only on the basis of fossils, and apparently went extinct before the arrival of humans. *T. maxima* was once quite common on reef flats as well as clear-water reef slopes, but has become scarce or disappeared on most reef flats. *T. squamosa* is rare and generally occurs in less accessible habitats. *H. hippopus* is known on Guam only from one live and a few dead specimens.

All species of *Tridacna* and *Hippopus* are phototrophic or they harbor single-celled plants (zooxanthellae) that manufacture most if not all of the clam's nutritional requirements. The clams therefore require relatively shallow, clear water with good exposure to sunlight, but do not require supplemental feeding. When under about 6 to 10 inches valve width, they are prone to predation by certain fishes (primarily rays and large triggerfishes and puffers) and drilling parasitic gastropods. Larger clams and those of reproductive age (5+ years) are relatively immune to predation.

In recent years it has been demonstrated that giant clams may be effectively cultured and transplanted. The species *Tridacna derasa* is the world's second largest bivalve, attaining a valve length of 60 cm, exceeded only by *T. gigas*. Both these species have proven to be the fastest growing and most feasible of the tridacnid clams to rear in captivity as well as in the wild (Heslinga, et al., 1984; Crawford et al., 1988). *Tridacna derasa* was chosen on the basis of its availability from the nearest hatchery. It is well adapted to lagoon environments which can be monitored more easily than exposed seaward reefs and has high potential for becoming established as a fishery resource.

One hundred broodstock (5 year old) giant clams (*Tridacna derasa*) were obtained from the Micronesian Mariculture Demonstration Center, Palau during the last quarter of FY89 and temporarily held at the Guam Aquaculture Training and Development Center at Fadian. Eighty seven of them were placed in unmarked sites within Apra Harbor between Sept. 1989 and January 1990, the remainder having died at the Fadian facility. Twelve clams

were placed at each of four Apra Harbor sites, 6 each at 4 - 5 and 9 - 10 m depths, respectively. Fifteen additional clams were placed in 10 m of water at the Glass Breakwater site in January 1990. By late February, 1990, most or all of the clams at all the 5 m sites except Sasa Bay and possibly a few of those at the 10 m Glass Breakwater sites had been poached, so those remaining were placed in 10 m. By mid-June 1990, all clams at the Glass Breakwater sites had been poached, leaving only those at the Sasa Bay and Jade Shoals Sites. The remaining clams are observed and measured approximately once a year to monitor growth and health. However, the clams at the inner Sasa Bay site have not been located recently due to frequent poor visibility.

OBJECTIVE

To introduce and establish the giant clam *Tridacna derasa* on the reefs of Guam.

PROCEDURES

Procedures for site selection, processing and field placement, and monitoring are given in the FY89 annual report. The results of measurements taken on October 16, 1991 were reported in the FY91 annual report. Due to the unusual frequency of typhoons, it was not possible to check the clams again until several weeks after the end of FY92. The clams at site B were located and measured on November 17 and those at sites C and D on December 1. One of the clams at site C was missing without any sign of shell remains in October, so it is presumed poached. Conditions in the harbor made it impractical to locate the clams at the Sasa Bay site A.

RESULTS

Positive growth was noted for all clams except one at site B, which was not included because it had been moved from a shallower site earlier in the study (Table 1). The clams at site B narrowly missed being destroyed by the grounding of the Navy vessel USS White Plains during Typhoon Omar. The top of the reef approximately 15 m to the east was badly damaged with many coral heads rolled downslope to depths of over 20 m and considerable slumping of the slope itself. However, the immediate vicinity of the clams seemed unaffected. One clam at site C was missing and presumed poached.

Table 1. Growth (mm) of transplanted *Tridacna derasa* between October 16, 1991 and November 17 or December 1, 1992.

Site	No. clams	No. days since last measured	Range in growth	Mean daily growth	Adjusted annual growth
B*	6	407	17-42	0.073	26.6
C	5	419	51-63	0.111	40.5
D	5	419	40-50	0.111	40.5

* Excludes 2 clams moved from 5 to 9 m during early stages of study.

During the most recent interval between measurements, mean daily growth rates ranged from 0.073 mm at site B to 0.111 mm at sites C and D. Growth of clams at site B decreased slightly while growth of clams at sites C and D increased slightly. These differences are slight and most likely a result of the small sample size.

RECOMMENDATIONS

It is recommended that this project remain active as long as transplanted clams are still living. Since over half of the transplanted clams were poached, no new clams should be placed until a more suitable area for seeding is found or a marine preserve with adequate enforcement is established. The clams at the deep Sasa Bay site A should be checked as soon as possible after several days of dry, calm weather. If lower than normal growth rates persist, all the clams at site A should be moved to a new 10 m site near site B. All sites should be photographically mapped to facilitate identification of individual clams so that growth can be tracked individually.

LITERATURE CITED

- Copeland, J. W. and J. S. Lucas, eds. 1988. Giant clams in Asia and the Pacific. Australian Center for International Agricultural Research, Monograph 9, Canberra, 274 pp.
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- Heslinga, G. A., and Perron, F. E., and O. Orak. 1984. Mass culture of giant clams (F. Tridacnidae) in Palau. *Aquaculture*, 39, 197-215.

Report prepared by: Robert F. Myers

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

JOB TITLE: Sea Turtle Monitoring Annual Report

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

During FY92 incidental to routine surveys, the shoreline waters and coastal beaches were monitored for sea turtle activity. During 22 aerial surveys, 100 sea turtles were surveyed. With the aid of the aerial survey and other beach observations, five nesting digs were identified, four by Green Sea Turtles and one by a Hawksbill Sea Turtle. Two of the four Green Sea Turtle digs were false crawls. Of the remaining two, one hatched successfully with 96 hatchlings, while the other was destroyed by Typhoon Omar. The only Hawksbill nest hatched successfully with 87 hatchlings.

BACKGROUND

Historically, harvest of sea turtles eggs on Guam was more common prior to World War II. Green Sea Turtles were harvested legally on Guam prior to August 1978 when the Green Sea Turtle (*Chelonia mydas*) was listed as threatened under the Endangered Species Act. The Hawksbill Sea Turtle (*Eretmochelys imbricata*) has been listed as endangered since 1970. In an effort to ensure the protection of Sea Turtles on Guam, routine counts of sighting are taken during aerial survey and nest sites are recorded and monitored for hatchlings.

OBJECTIVE

To obtain and record as much information about activities on Guam pertaining to sea turtles.

PROCEDURES

Aerial surveys were conducted twice a month to identify fishermen and fishing areas, but incidental observations of turtles were also recorded. The single engine fixed wing aircraft plane flies between 300 and 500 ft in altitude and makes one counterclockwise pass around the island. Surveys are conducted in conjunction with randomly selected creel surveys which rotate through a series of hourly starting times ranging from 0800 to 1200. This survey was not designed for turtle observations and therefore the information is not always collected under ideal conditions. The data collected includes turtle numbers and the locations observed. Turtles are identified to species when possible but this is often not possible.

If turtle tracks were reported to DAWR or sighted on the aerial survey a beach inspection was conducted to determine if the crawl was a nesting event and if the nest contained eggs. If the nest contained eggs a determination of hatch time was estimated for confirmation of hatch. Records of number of hatchlings were recorded either by observation or counts of eggshells. Within a couple days of the hatch the nests were also dug out to check for

turtles which may be trapped or eggs which did not hatch. Additionally, routine surveys of common nesting areas were conducted during the nesting season to check for potential nest sites, which may have not been detected by other methods.

RESULTS

Twenty-two flights and a number of beach visits were made during 1992. Two aerial surveys had to be canceled due to poor flying conditions. The turtle species observed during the aerial surveys were Greens and Hawksbills. When comparing historical counts from aerial observations with two flights per month from 1975-79 versus 1991-92, the numbers seen are 783 turtles in 41 months (19 per month) and 100 turtles in 11 months (9 per month), respectively. These averages suggest that the turtle populations around Guam have declined. There is however an indication that the fluctuations may be more closely related to flight conditions and not necessarily a measure of population fluctuations. It is also not known how transient or seasonal the turtle population around Guam is and therefore it is not known specifically what these counts represent. Until the effects of these parameters can be analyzed it will not be appropriate to use this information as an abundance survey. It will however be useful for forage and habitat utilization indices.

NESTING SITES

Sea turtle nesting activity on Guam seemed particularly low during FY92. The cause of this is not known. The amount of monitoring on turtle nesting is not sufficient for a comprehensive survey of these events and it is therefore possible for a significant amount of nesting to occur without being detected. Accessibility to some areas and the difficulty in detecting tracks while on aerial flights also add to the data deficiency and accuracy of the present information. The following nesting events were recorded:

Cocos Island - A Green Sea Turtle attempted to dig 6 times but sand was not deep enough. The Cocos Island beaches were eroded extensively by Super Typhoon Yuri and this attempted nesting activity was a pleasant surprise after such a natural disaster. This activity supports the idea of restoring known nesting areas, which may be damaged. If sand from the area can be used to replenish these beaches it is expected that turtles will use these sites to nest again.

Castro Beach - A Green Sea Turtle made a false nest, which is more accurately described as an abandoned dig due to a large rock encountered in the middle of the pit.

Falcona Beach - Two Green Sea Turtle nests were inspected and confirmed to having eggs. One nest produced 96 hatchlings and no undeveloped eggs. The second nest was destroyed by Typhoon Omar on August 28.

Sumay Cove - An estimated 87 hatchlings emerged from a single nest at Sumay Cove. There were two undeveloped eggs remaining in the nest, which was expected to have been a Hawksbill nest because they have used this location in the past.

OTHER SEA TURTLE ACTIVITIES

On February 29, two small green sea turtles were oiled and recovered. These were unusually small turtles, which are common in the area. These events indicate that these small individuals do forage in the area and need to be considered when offshore activities are planned. The details of this activity can be further researched in the filed incident report.

During FY92 two arrests were made concerning sea turtles. One arrest involved the spearing of several Green Sea Turtles and the other incident dealt with the sale of turtle products. These arrests involved four individuals.

AGENTS THREATENING SEA TURTLES ON GUAM

Habitat destruction continues to be the primary concern in conserving Guam sea turtles and has been occurring mainly due to construction and development. This is also a function of insufficient information about the turtle activities specific to Guam, which would allow the development of a more comprehensive plan for protection (foraging and nesting).

Another impact resulting from development and poor land management is sedimentation, which has damaged coral reefs. This could have serious effects on the food sources for various turtles. With an increasing human population and continued rapid land development, the potential negative impacts to sea turtle foraging and nesting habitat continues to increase.

Predation is another impact, which is difficult to assess. This includes illegal harvest by fishermen along with harvest by predators on nests. We do not have much of a problem with predation of hatchlings by birds but there have been observations of crab predation. Incidental catch does occur (illegal fishing in the EEZ and accidental gillnet capture along certain beaches) but the degree of this impact is not known. The large amount of longline fishing for tuna done just outside Guam's EEZ poses a potential major threat to the turtles if catchable by this manner of fishing. There are also neighboring countries which do not prohibit turtle harvest like Palau and the Philippines which impact overall Western Pacific turtle numbers.

RECOMMENDATIONS

1. Establish a protocol for regulating beach use in valuable turtle nesting areas. This is particularly true for Northern Guam where significant vehicle use on valuable turtle nesting beaches has been observed.
2. Since most of Guam's beaches are expected to have been sea turtle nesting beaches at one time it is now apparent human impacts have reduced the number of nesting beaches on Guam significantly. It is recommended that this project be formalized and expanded to gather more extensive site specific nesting information. Since the nesting cycle can take as long as seven years it is recommended that a thorough effort to identify nesting beaches be implemented over a seven-year period. The present survey technique can provide important information in the design of such a survey but in no way should be considered extensive enough to provide accurate full coverage of the island-wide nesting activities. Given the rapid development of Guam, waiting to implement such a project only adds to the areas, which will no longer be used. If the merits of such a project are approved, funding and staff will need to be pursued to implement and complete this project.

Report prepared by: Gerald W. Davis

GUAM COMMERCIAL FISHERIES

STATE: Territory of Guam

JOB TITLE: Commercial Fisheries on Guam

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Commercial landings of locally caught fish are an important component of our total fisheries catch. The troll (pelagic) caught fish continue to make up the majority of the total fish landed by weight. Reef fish, bottom fish, imported fish, other fish and invertebrates made up a smaller portion of the catch. The data for this fiscal year was sent to NMFS in Hawaii for processing. The summary data is available from NMFS or our office.

BACKGROUND

The Commercial Fisheries Program was established to learn more about the fishery resource being caught and sold on Guam. In the past, the National Marine Fisheries Service (NMFS) has only collected data from the Guam Fishermen's Cooperative in Agana. Because it is difficult for NMFS to manage the data collection program from Hawaii, the DAWR has coordinated the data collection since January, 1990.

OBJECTIVES

To monitor, analyze and report on locally caught fish sales and related activities through the collection of vendor receipts

PROCEDURES

There are three cooperating vendors presently providing receipt data to the program. The Guam Commercial Fisheries receipt books are provided to each vendor in the program. Each receipt asks for information to be completed by each cooperating vendor while the catch is being purchased. On each receipt, there is a space provided for the name of the person providing the catch, fisherman number, date, number of fishermen, hours fished, fishing location and fishing method. The fishing location number and fishing method code are determined by using the chart included on the inside of each receipt book cover. The catch information is broken down into six primary areas: (1) Bottom fish, (2) Reef fish, (3) Troll fish, (4) Invertebrates, (5) Seaweeds and (6) Imported Items. Each item has a code number to identify the fish, invertebrate, or seaweed. Space is provided to indicate the number of items, total weight, price paid per pound, the value of the items, the total value of the transaction and any additional remarks about the transaction. There are three copies of each receipt with one for the person representing the catch, one for the vendor, and one for processing the information into the computer data base.

The vendors were visited on a regular basis to monitor the completion of the forms, collect completed receipt books, check data completion, and insure that they had a supply of receipt books. A log book was used to record when a receipt book was initially given and received back from the vendor. When a receipt book was returned, the name of the vendor was indicated on the outside at the top to indicate which vendor completed the receipt book.

The receipt books were transmitted to the NMFS office at Hawaii for data processing and sent back.

RESULTS

During FY92, 52 receipt books were collected from the cooperating vendors and processed at Hawaii. Summary data was sent back to us with monthly and year end totals. The data is presented in the "Fishery Statistics of the Western Pacific" and the bottom fish and pelagic plan monitoring team annual reports.

DISCUSSION

In the past, almost all the data quality control was performed by NMFS in Hawaii. During the past FY however, forms were inspected and checked by DAWR prior to submittal to NMFS. Each receipt is coded with a number according to who made the transaction with the vendor. We presently do the coding for two vendors and verify coded receipts for the other cooperating vendor.

Our initial intent was to analyze the summary data received from Hawaii. Because the quality control of the data takes up most of our available time at the office, further analysis of the data locally has been put on indefinite hold. The summary data can be obtained in the "Fishery Statistics of the Western Pacific" published annually by the National Marine Fisheries Service in Honolulu, Hawaii or by contacting our office.

At this time, the cooperators with the commercial fisheries program are voluntary. We feel that we are covering about 80% of the locally caught fish sold on Guam. We are not covering imported frozen fish and the many roadside vendors along the hi-way that are importing fish from the Philippines and/or Micronesia. The primary goal of the program is to gather as much information as we can about our fisheries resource and have the collected data represent a complete picture of the locally caught and sold fish.

RECOMMENDATIONS

1. A law or regulations be passed that would require that people use an identification number in selling their catch to vendors and for vendors of local fish products to use our commercial fisheries receipts in their business transactions. This would give us a more comprehensive view of the commercial fisheries activity around Guam. If such a law or regulation is passed, the person working directly with new vendors should be accompanied by a Conservation Officer until they use the receipts on a regular basis with no hesitation and/or resistance.

Report prepared by: Wayne Kruckenberg

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: W-1

STUDY NO.: 1

JOB NO.: 1

JOB TITLE: Determination of Current Population Size and Distribution of Guam Deer

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Population trend data obtained with spotlight counts indicated a significant decrease ($p < 0.05$) in deer numbers at Andersen Air Force Base (AAFB), while Naval Magazine (NAVMAG) recorded a significant increase ($p < 0.05$). During the deer season, shotgun hunters made 2064 sorties and expended 907 hunter days harvesting 58 deer in Northwest Field (NWF). Bow hunters made 612 sorties and expended 248.3 hunter days to harvest 11 deer in the AAFB bow area and Conventional Weapons Storage Area (CWSA). At the Naval Computer and Telecommunications Area Master Station (NCTAMS; formerly NAVCAMS) hunters made 503 sorties and expended 64.3 hunter days to harvest 4 deer.

BACKGROUND

The Guam deer (*Cervus mariannus*) has been under investigation by the Division of Aquatic & Wildlife Resources (DAWR) since 1961. Its distribution, population trends, and biology have been described by Wheeler (1979). Deer hunting statistics have been compiled since 1968 through hunter reporting procedures. The regular deer season is October 1 through December 31 with a bag limit of one antlered deer (buck only) per season per license holder, exclusive of any special hunt harvest. The Director of Agriculture can authorize a special either-sex hunt to thin a particular herd in situations where the population poses a threat to life and property and to prevent damage to other natural resources from over grazing.

OBJECTIVES

To determine the current size and distribution of the deer population on Guam and to monitor population trends.

PROCEDURES

1. Continue spotlight counts on AAFB at 21 counts per year, four per month in May-July and one per month in other months.
 - a. Record number, age, sex and group composition.
 - b. Statistically analyze count data and compare with past data to discern population trends.
2. Continue monthly spotlight counts on NAVMAG with periodic spotlight counts in other areas.
3. Collect hunting statistics via a hunter questionnaire. Analyze hunting statistics for changes in hunter kill, effort, and hunting location.
4. Collect biological data from carcasses killed during regular season and special hunts or from incidental sources such as road kills or confiscated animals.

RESULTS

Deer Hunting Statistics

License sales increased during FY92 with 628 sold during the year. Because harvest questionnaires on FY92 hunting could not be sent out in time to include responses in this report, the results will be included in next year's deer report.

A record of hunting activity and harvest is kept at AAFB and NCTAMS during the regular season (Table 1). According to logs, 64.5 hunter-days (503 hunter-sorties) were expended on NCTAMS and resulted in the harvest of 4 deer. Because of incomplete records, this estimate is not an accurate account of hunter effort per take.

Table 1. Hunter effort and deer take based on official hunter logs from Andersen Air Force Base for Northwest Field, the Conventional Weapons Storage Area (CWSA), and bow areas during FY92.

	1991			1992	
	Oct	Nov	Dec	Sep	Total
Andersen Air Force Base					
Northwest Field					
No. Hunter Sorties	555	439	611	459	2064
No. hunter days (8-hr.)	249	190	281	188	907
Deer taken	10	7	17	24	58
Days effort/take	24.9	27.2	16.5	7.8	76.4
Bow Areas on Main Base					
No. Hunter Sorties	106	116	129	79	430
No. hunter days (8-hr.)	43.9	51.1	43.9	25.4	164
No. Deer taken	0	0	0	0	0
Days effort/take	0.0	0.0	0.0	0.0	0.0
CWSA					
No. Hunter Sorties	0	11	115	56	182
No. hunter days (8-hr.)	0	5.38	49.5	29.4	84.3
No. Deer taken	0	0	1	0	1
Days effort/take	0.0	0.0	49.5	0.0	49.5
NCTAMS					
No. of Hunter Sorties	122	140	172	69	503

No. of Hunter Days	59.4	76.7	93.2	28.7	64.5
Deer Taken	0	2	1	1	4
Days effort/take	0.0	38.4	93.2	28.7	40.1

According to AAFB hunter logs, 907 hunter-days (2064 hunter-sorties) were expended in NWF and resulted in the harvest of 58 deer (Table 1). Bow areas on the main base recorded 164 hunter-days (430 hunter-sorties) with no deer taken.

The CWSA, a newly opened hunting area, recorded 84.3 hunter-days (182 hunter-sorties) and one deer taken (Table 1). Hunters were required to remain on dirt roads while hunting in this area, which may have made hunting deer more difficult.

Responses to harvest questionnaires for last year (FY91) are reported in Table 2. Of the 600 questionnaires sent out, 110 hunters responded. An estimated 252 deer hunters spent 4,749 days to harvest 78 deer, with an estimated 61 days expended per deer taken.

Table 2. Summary of island-wide deer hunting statistics for FY91 derived from hunter questionnaires.

a. Total license sales for all game species.	615
b. Number of questionnaires sent out.	600
c. Number of questionnaires returned.	110
d. Percent queried license buyers that hunted any species.	18.33%
e. Number of reporting license buyers that hunted any species.	73
f. Percent of license buyers that hunted.	66.36%
g. Estimated total number of legal hunters.	408
h. Number of reporting hunters (73) that hunted deer during the regular season.	45
i. Percent of reporting hunters that hunted deer during the regular season.	62%
j. Number of deer taken by deer hunters.	14
k. Hunter success.	31%
l. Hunter-days expended by reporting deer hunters.	848
m. Average number of days spent per reporting deer hunter.	19
n. Estimated total number of legal deer hunters.	252
o. Estimated total deer take.	78
p. Estimated total number of days spent hunting deer.	4,749
q. Number of days spent hunting per deer taken.	61

Spotlight Count Trends

Deer numbers were smaller on AAFB during FY92 (Table 3). Numbers observed during May-July, the best period for sighting deer, were not significantly different from FY91 (Mann-Whitney U-Test, $U = 117$, $n_1=13$, $n_2=13$, $p>0.05$).

The average number of deer seen per count decreased 23% from 87.4 during May-July 1991 to 67.7 during May-July, 1992. However, numbers observed throughout the entire year declined from the previous year (Mann-Whitney U-Test, $U = 126$, $n_1=12$, $n_2=12$, $p<0.001$), falling from 86.9 in FY91 to 60.4 in FY92. The largest single nightly count decreased from 132 deer (200 deer per 10 km) in FY91 to 99 deer (134 deer per 10 km) in FY92.

Table 3. Composition of deer herd during spotlight counts at AAFB, Guam. (CNT = Count, Ave = Average, SD = Standard Deviation).

1991				1992												
	CNT	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Sum	Ave	SD
Un-Classed Buck	1	0	1	0	2	2	2	1	3	0	2	1	0	37	1.7	1.4
	2								1	1	3	1				
	3								3	2	1					
	4								1	5	5					
	5										1					
	Ave.	0.0	1.0	0.0	2.0	2.0	2.0	1.0	2.0	2.0	2.4	1.0	0.0			
Spike	1	0	0	0	2	1	0	0	0	1	2	2	0	18	0.8	0.9
	2								1	1	2	1				
	3								3	0	1					
	4								0	0	1					
	5										2					
	Ave.	0.0	0.0	0.0	2.0	1.0	0.0	0.0	0.8	0.5	1.6	1.5	0.0			
2pt	1	1	3	1	3	2	2	1	2	2	2	2	1	38	1.7	1.1
	2								4	1	4	1				
	3								1	0	0					
	4								1	3	1					
	5										3					
	Ave.	1.0	3.0	1.0	3.0	2.0	2.0	1.0	1.8	1.5	2.0	1.5	1.0			
3pt	1	1	0	2	1	2	1	2	3	1	1	4	0	46	2.1	1.5
	2								2	2	4	3				
	3								5	2	4					
	4								0	1	5					
	5										3					
	Ave.	1.0	0.0	2.0	1.0	2.0	1.0	2.0	2.5	1.5	3.4	3.5	0.0			
4pt	1	0	0	0	0	1	0	0	4	0	0	1	0	8	0.4	0.9
	2								0	0	0	0				
	3								0	1	0					
	4								0	0	1					
	5										0					
	Ave.	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.3	0.2	0.5	0.0			
Doe	1	15	19	22	20	26	18	39	39	12	21	29	8	571	26.0	10.0
	2								43	17	20	19				
	3								38	31	27					
	4								38	33	37					
	5										30					
	Ave.	15.0	19.0	22.0	20.0	26.0	18.0	39.0	39.5	23.3	27.0	24.0	8.0			
Yearling	1	7	2	0	2	5	3	8	4	1	7	6	2	125	5.7	3.7
	2								6	1	8	10				
	3								9	2	10					
	4								13	8	11					
	5										19					
	Ave.	7.0	2.0	0.0	2.0	5.0	3.0	8.0	8.0	3.0	11.0	8.0	2.0			
Fawn	1	0	0	4	4	0	0	2	1	1	2	2	0	21	1.0	1.2
	2								1	0	1	0				
	3								1	0	1					
	4								1	0	0					
	5										2					
	Ave.	0.0	0.0	4.0	4.0	0.0	0.0	2.0	1.0	0.3	1.2	1.0	0.0			

Deer numbers increased significantly on NAVMAG during FY92 (Mann Whitney U-Test, $U=97$, $n_1=12$, $n_2=10$, $p<0.05$) as compared to the previous year. The average number of deer per count increased from 25.0 deer in FY91 to 33.5 deer in FY92 (Table 4). The largest single nightly count increased from 35 deer (15.6 deer per 10 km) in FY91 to 57 deer (23.6 deer per 10 km) in FY92.

Table 4. Composition of deer herd during spotlight counts at Naval Magazine, Guam.

1991 1992															
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Mean	SD
Unclassed buck	0	1	0	1	2	3	1	1	2	3	N O	1	15	1.4	1.0
Spike	0	0	1	2	1	1	1	0	0	0		0	6	0.5	0.7
2pt	1	0	1	5	1	1	1	1	1	0	D	1	13	1.2	1.3
3pt	0	1	1	4	2	2	1	0	0	0		5	16	1.5	1.7
4pt	0	0	1	0	1	1	0	0	0	0	A	2	5	0.5	0.7
Doe	6	15	10	27	12	13	10	5	23	16	T	13	150	13.6	6.6
Yearling	3	3	5	1	1	2	2	2	9	7	A	3	38	3.5	2.5
Fawn	1	1	1	2	2	0	2	0	0	2		2	13	1.2	0.9
Unclassed deer	5	3	3	15	13	17	9	7	18	6		17	113	10.3	5.9
Total	16	24	23	57	35	40	27	16	53	34		44	369	33.5	13.9
Miles traveled	16	15.2	15	15	14	15	14.3	12.3	16.2	14.7		16.9	164.6	15.0	
Km traveled	25.7	24.5	24.1	24.1	22.5	24.1	23.0	19.8	26.1	23.7		27.2	264.9	24.1	
Deer/10 mi	10.0	15.8	15.3	38.0	25.0	26.7	18.9	13.0	32.7	23.1		26.0	244.6	22.2	8.6
Deer/10 km	6.2	9.8	9.5	23.6	15.5	16.6	11.7	8.1	20.3	14.4		16.2	152.0	13.8	5.3

RECOMMENDATION

Continue spotlight counts at present intensity at NAVMAG and AAFB. Collect biological data from carcasses as available.

LITERATURE CITED

- Division of Aquatic and Wildlife Resources Division. 1991. Job Progress Report. Federal Aid to Fish and Wildlife Restoration. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao.
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Report prepared by: Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Wild Pigs on Guam

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

According to official logs of harvest statistics for Andersen Air Force Base (AAFB), Northwest Field (NWF) recorded a total hunting effort of 5050 hunter-sorties comprising 1823.5 hunter-days, with a harvest of 503 pigs and an effort/harvest of 3.6 days per pig. Naval Computer and Telecommunications Area Master Station (NCTAMS) had 903 hunter-sorties and a harvest of 47 pigs.

BACKGROUND

The wild pig (*Sus scrofa*) has long been an important natural resource on Guam and accounts for the greatest annual hunter recreation and harvest of all game animals. This species has been under investigation by the Division of Aquatic and Wildlife Resources (DAWR) since 1967 (Conry 1988). The wild pig on Guam is a descendant of domestic *Sus scrofa* introduced by the Spanish from the Philippines between 1672 and 1685. Wild pigs are found island-wide but appear to be most numerous in the limestone forests of the north and the ravine forests of southern Guam. Pig densities occur high enough in many areas that rooting and wallowing damage are common in most forested areas and can be quite severe locally. Depredation on agricultural crops is also a problem, particularly for farmers in southern Guam during the dry season. Controlling the effects of pig damage is recognized as an important measure to protect native forest and agricultural resources. Recreational harvest is the primary tool used to control pig numbers and current hunting regulations provide for a year-round season with bags limits of two pigs per day and 40 per year. There is a need to consider more liberal regulations to control pig populations island-wide and in localized areas.

OBJECTIVES

To monitor trends in pig population size, hunter participation, and harvest.

PROCEDURES

1. Record pig sightings during deer spotlight counts, and observations of pigs or pig sign during other fieldwork.
2. Monitor hunter participation and harvest during the legal hunting season.

RESULTS

Overall license sales increased 2% during FY92, with 628 sold during the year. Because harvest questionnaires for FY92 could not be sent out in time to include in this year's report, the information will be published in the FY93 report.

Responses to last year's (FY91) harvest questionnaires are reported in Table 1. Six hundred questionnaires were sent out, of which 110 hunters responded. Of the estimated 408 hunters in the FY91 season, 313 hunted pigs. Hunters expended an estimated 7,182 hunter days harvesting 1,587 pigs in FY91.

Table 1. Summary of island-wide pig hunting statistics for FY91 derived from hunter questionnaires.

a. Total license sales for all game species.	615
b. Number of questionnaires sent out.	600
c. Number of questionnaires returned.	110
d. Percent queried license buyers that hunted any species.	18%
e. Number of reporting license buyers that hunted any species.	73
f. Percent of license buyers that hunted.	66%
g. Estimated total number of legal hunters.	408
h. Number of reporting hunters (73) that hunted pig during the regular season.	56
i. Percent of reporting hunters that hunted pig during the regular season.	77%
j. Number of pigs taken by pig hunters.	284
k. Hunter success.	75%
l. Hunter-days expended by reporting pig hunters.	1285
m. Average number of days spent per reporting pig hunter.	22.9
n. Estimated total number of legal pig hunters.	313
o. Estimated total pig take.	1587
p. Estimated total number of days spent hunting pig.	7182
q. Number of days spent hunting per pig taken.	4.5

A record of hunting activity and harvest was kept at NCTAMS and AAFB (Table 2). Data from AAFB includes the Conventional Weapons Storage Area (CWSA), which was opened for hunting in November 1991. Only bow hunting was allowed in this area.

Based on hunter logs, NWF recorded 1219.6 hunter-days (2874 hunter-sorties) and resulted in the harvest of 243 pigs (Table 2). Bow areas recorded 310 hunter-days (876 hunter-sorties) and resulted in the harvest of 118 pigs. CWSA recorded 302.9 hunter-days (650 hunter-sorties) and resulted in the harvest of 142 pigs.

Table 2. Hunter effort and pigs take based on official hunter logs from Naval Computer and Telecommunications Area Master Station (NCTAMS), Northwest Field, and Andersen Air Force Base during FY92.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
NCTAMS													
No. hunter sorties	122	140	172	45	34	44	59	65	39	61	53	69	903
No. hunter days (8hr)	59.4	76.7	93.2	24.3	14.4	20.8	29.3	34.1	16.9	31.2	21.9	28.7	37.6
Pigs taken	2	8	6	0	3	4	6	5	1	4	3	5	47
Days effort/take	29.7	9.6	15.5	0.0	4.8	5.2	4.9	6.8	16.9	7.8	7.3	5.7	9.5

Andersen Air Force Base

Northwest Field

No. Hunter Sorties	555	439	611	79	139	96	82	112	73	138	91	459	2874
No. hunter days (8-hr.)	249	190	281	33.5	52	34.8	30.5	42.9	29.4	54.9	34.6	188	1219.6
Pigs taken	32	9	37	13	15	10	16	26	18	24	24	19	243
Days effort/take	7.8	21.1	7.6	2.6	3.5	3.5	1.9	1.6	1.6	2.3	1.4	9.9	64.8

Bow Areas on Main Base

No. Hunter Sorties	106	116	129	65	46	74	65	53	38	65	40	79	879
No. hunter days (8-hr.)	43.9	51.1	43.9	17.8	13.9	23.3	20.9	19.3	12.5	23.3	15	25.4	310
Pigs taken	8	9	13	5	6	12	14	16	12	8	9	6	118
Days effort/take	5.5	5.7	3.4	3.6	2.3	1.9	15	1.2	1.0	2.9	1.7	4.2	34.9

CWSA

No. Hunter Sorties	0	11	115	41	79	68	41	35	53	74	47	56	650
No. hunter days (8-hr.)	0	5.38	49.5	1.91	41.6	34.4	19.1	33.6	23.8	24.9	22.1	29.4	302.9
Pigs taken	0	5	40	8	21	9	2	24	8	11	7	7	142
Days effort/take	0	1.1	1.2	2.4	2.0	3.8	9.6	1.4	3.0	2.3	3.2	4.2	34.1

When logs of FY91 were compared to FY92 (DAWR 1991), NWF recorded a 13% increase in the number of pigs harvested, rising from 216 to 243 pigs. The number of hunter-days increased 20% from 1049.6 to 1219.6 hunter-days. Although bow areas showed a 23% decrease in the number of hunter-days, the number of pigs harvested increased 22%.

A total of 903 hunter-sorties and a harvest of 47 pigs were recorded on NCTAMS. Although this is a 200% increase in harvest, the comparison with last year may not be valid because the base was closed for hunting during part of FY91 (DAWR 1991).

RECOMMENDATIONS

Continue to monitor the annual pig harvest and hunter participation. Coordinate accurate record keeping and reporting of hunter effort and harvest at military bases.

LITERATURE CITED

Conry, P. J. 1988. Ecology of the wild (feral) pig (*Sus scrofa*) on Guam. Tech. Rept. No. 7. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao. 60 pp.

Division of Aquatic and Wildlife Resources. 1991. Job Progress Report - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Report prepared by: Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: W-2

STUDY NO.: 1

JOB NO.: 2

JOB TITLE: Population Numbers and Distribution of Philippine Turtle-Doves

PERIOD COVERED: October 1, 1991 to September 30, 1992.

SUMMARY

The spring game bird survey conducted this year showed no change in the relative abundance of Philippine Turtle-Doves (*Streptopelia bitorquata*) over last year's count. However, stationary counts at Northwest Field (NWF) and Conventional Weapons Storage Area (CWSA) had significant decreases in numbers ($p < 0.05$) birds/station.

BACKGROUND

The Philippine Turtle-Dove was introduced to Guam by the Spanish during their early colonization of the region, circa 1771 (Baker 1951), and has been regulated as a game bird since at least 1903 (Conry 1987). Up through the early 1960s, the turtle-dove was very common and found in large numbers of northern and southern Guam. By the late 1960s, dove populations in southern and central Guam began to decline and have since stabilized at low levels. Populations in northern Guam declined in the late 1970s and early 1980s. Turtle-doves are now found in appreciable numbers in prime dove habitat on NWF, CWSA and elsewhere on Andersen Air Force Base (AAFB), and at moderate numbers in selected areas of central and southern Guam. A large population still remains on snake-free Cocos Island. Predation by the brown tree snake (*Boiga irregularis*) is the major cause of nest loss (Conry 1988) and this introduced pest is thought to be responsible for the population decline. Because of the decline in numbers and the extremely poor nesting success, the Department of Agriculture officially closed the turtle-dove hunting season as of March 28, 1987. The season will be reopened if nesting success improves and numbers recover to a level that can support recreational hunting.

OBJECTIVES

1. To determine present population levels and distribution, and monitor population trends.
2. To investigate nesting success and causes of nest failures.

PROCEDURES

Call-count and roadside count surveys were conducted at NWF and CWSA on AAFB. Both surveys were conducted once to twice monthly in early morning. The call-count survey consisted of counting the number and species of doves seen or heard during a 5-minute period at 10 stations in NWF plus the number of doves seen enroute between stations. The roadside count survey at CWSA involved counting the number of Philippine Turtle-Doves seen while driving at 25 km per hour along an established 32 km route.

Turtle-doves are also included in a twice monthly roadside count of all birds conducted in three areas of northern Guam. The results of these surveys are reported in Job W-1-3.

Doves were additionally surveyed during spring game bird counts conducted on 23 routes throughout the island in June. These surveys consisted of 5-minute station counts at up to 10 stations per route with the number of birds seen or heard recorded at each station. Results are summarized as the average number of birds observed per station.

RESULTS

Population Surveys

Call count surveys and roadside counts were continued at NWF and CWSA on AAFB (Table 1). Surveys on NWF showed a significant decrease over the previous year (Mann Whitney U-Test, $n_1 = 10$, $n_2 = 14$, $U = 134$, $p < 0.001$). The average count decreased (75%) from 29.6 birds/survey in FY91 (DAWR 1991) to 7.4 birds/survey in FY92.

Table 1. Results of Philippine Turtle-Dove surveys at Northwest Field (NWF) and the Conventional Weapons Storage Area (CWSA) on Andersen Air Force Base, Guam during FY92.

Month	NWF Surveys			CWSA Surveys		
	1	2	Average	1	2	Average
1991						
October	13	11	12.0	21	16	18.5
November	3	6	4.5	17	8	12.5
December	9	10	9.5	9	11	10.0
1992						
January	2		2.0	9		9.0
February	6		6.0	7		7.0
March	9		9.0	10		10.0
April	No data			8		8.0
May	12		12.0	9		9.0
June	6		6.0	7		7.0
July	7		7.0	21		21.0
August	11		11.0	8		8.0
September	3		3.0	6		6.0
Survey Average			7.4			10.5

Roadside counts in the CWSA exhibited a similar trend with a significant change over the previous year's counts (Mann Whitney U-Test, $n_1 = 13$, $n_2 = 15$, $U = 181$, $p < 0.001$). The average count per survey decreased (44%) from 18.9 birds/count in FY91 to 10.5 birds/count in FY92.

Spring Game Bird Surveys

Turtle-doves were recorded on 21 of 22 spring game bird surveys in 1992 (Table 2). Cocos Island continues to have the highest count by far, with an average of 5.2 birds observed per station. The NWF, Mt. Santa Rosa and Ija routes had station counts ≥ 1.0 birds/station. There was no significant change from last year's survey (Wilcoxon Signed-rank Test, $Z = -0.226$, $p > 0.05$).

Table 2. Numbers of Philippine Turtle-Doves observed per count and average number of birds per station, as detected in spring game bird surveys at various locations on Guam during May 1992. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Doves Observed	1992 Ave./ station	1991 Ave./ station	Trend in Ave. 92-91
Tarague	10	4	0.40	0.89	-0.45
CWSA	10	9	0.90	1.10	-0.20
NWF	10	12	1.20	0.10	0.10
NCTAMS	10	4	0.40	0.20	0.20
Capitol Improvement Road	10	3	0.30	0.50	-0.20
Mt. Santa Rosa	10	16	1.60	0.60	1.00
Y-Sengsong	10	3	0.30	1.20	-0.90
Two Lovers Point	10	3	0.30	0.00	0.30
Andy South	10	5	0.50	0.50	0.00
Navy Golf Course, Barrigada	10	6	0.60	0.70	-0.10
Barrigada Hill	10	5	0.50	0.67	0.17
Toto Pipeline	10	0	0.00	0.00	0.00
Nimitz Hill	10	4	0.40	0.10	0.30
Reserve Craft Beach Road	4	2	0.50	2.50	-2.00
Orote Point	6	0	0.00	1.00	-1.00
Pulantat	10	1	0.10	0.00	0.10
Cross Island Rd.	10	4	0.40	0.20	0.20
NAVMAG	10	6	0.60	0.50	0.10
Umatac	10	2	0.20	0.40	-0.20
Dandan	10	5	0.50	0.20	0.30
Ija	10	10	1.00	0.80	0.20
Merizo	10	1	0.10	0.11	0.01
Cocos Island	10	52	5.20	5.70	-0.50

RECOMMENDATIONS

1. Continue call count and roadside count surveys in northern Guam to monitor distribution, relative abundance and population trends of the Philippine Turtle-Dove.
2. Keep Philippine Turtle-Dove hunting season closed until nesting success improves and the population recovers.

LITERATURE CITED

- Baker, R.H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. University of Kansas Pub. 3(1):1-359.
- Conry, P. J. 1987. Ecology of the Philippine Turtle-Dove on Guam. Tech. Report No. 6. Div. Aquatic Wildl. Res., Dep. Ag., Mangilao.
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Report prepared by Celestino F. Aguon

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-29
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Preparation of a Status Report and a Species Management Plan for the
Black Francolin

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

This project was inactive during FY92 due to lack of staff.

Report Prepared by: Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Black Francolin on Guam.

PERIOD COVERED: October 1, 1991 to September 30, 1992.

SUMMARY

Eleven survey routes had decreases, 7 had increases of 1 or less birds, and 5 routes had no change in the numbers of Black Francolin, *Francolinus francolinus*. The overall pattern of change was statistically significant ($p < 0.05$) compared to FY91 spring game bird counts. Francolin occurred on 16 of 23 survey routes conducted throughout Guam. Francolin populations are well established throughout southern Guam and continue to expand their range into shrub-grass habitats in central and northern Guam. This species appears able to sustain the current levels of recreational hunting.

BACKGROUND

In 1961, 171 Black Francolin (*Francolinus francolinus*) were introduced in southern Guam as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. Surveys conducted in 1980 indicated the population was adequately established in most parts of southern Guam to open a hunting season. Regulations were promulgated to open a one-month season in December 1981 with a four bird daily limit and a 20 bird season limit. Francolin populations continued to increase from 1980-1982, but hunting pressure remained low, probably because of the unfamiliarity of the hunting public with the sporting qualities of the bird. With the bird population consistently increasing and little hunting pressure, the francolin season and bag limits were further liberalized in FY '83 to a two-month split season, one month in January, and one month in July, and the bag limit was increased to 5 birds per day with no season limit. Revisions to the francolin season were again made in FY90 extending the season from January 1 to February 28 and from July 1 to August 31. Francolin hunting has increased in popularity and Guam hunters are successfully harvesting birds during the open seasons. Regulations implemented in FY '83 remain in effect with hunter participation and adherence to game laws monitored by spot checks by biologists and conservation officers of the Division of Aquatic and Wildlife Resources (DAWR).

OBJECTIVES

To determine current relative abundance and current distribution of Black Francolin on Guam and monitor population trends and hunter harvest.

PROCEDURES

1. Conduct annual island-wide spring game bird surveys (station counts) to monitor distribution and status of francolin throughout the island.

2. Conduct twice weekly station-count surveys during May-June to monitor pre-hunting season status of francolin population in Dandan, Inarajan.
3. Monitor hunter harvest via an annual harvest questionnaire. Collect information on hunter participation, effort, harvest, and areas hunted.

RESULTS

Because FY91 harvest questionnaires were not be included in last year's annual report, those responses are discussed here. Of the 600 questionnaires sent out, 110 hunters responded. An estimated 408 hunters hunted in the FY91 season. Of these, an estimated 89 hunters hunted francolin, spending 816 days to harvest 794 birds. An estimated 0.97 days were expended per bird taken (Table 1).

Table 1. Summary of islandwide Black Francolin (BLFR) hunting statistics for FY91 derived from hunter questionnaires.

	Jan-Feb 91	Jul-Feb 91	Total
a. Total license sales for all game species.			615
b. Number of questionnaires sent out.			600
c. Number of questionnaires returned.			110
d. Percent queried license buyers that hunted any species.			18%
e. Number of reporting license buyers that hunted any species.			73
f. Percent of license buyers that hunted.			66%
g. Estimated total number of legal hunters.			408
h. Number of reporting hunters (73) that hunted BLFR during the regular season.	10	6	16
i. Percent of reporting hunters that hunted BLFR during the regular season.	14%	8%	11%
j. Hunter success.	80%	83%	81%
k. Number of BLFR taken by reporting hunters.	103	39	142
l. Average number of BLFR taken per hunter.	10.3	6.5	8.9
m. Average number of BLFR taken per successful hunter	12.9	7.8	10.9
n. Reported number of days spent hunting.	105	41	146
o. Average number of days spent hunting.	10.5	6.8	9.1
p. Estimated total number of legal BLFR hunters.	56	34	90
q. Estimated total legal BLFR harvest	576	218	794
r. Estimated total number of days spent hunting.	587	229	816
s. Number of days spent hunting per BLFR taken.	1.02	1.05	1.03
t. Number of BLFR taken per day hunting.	0.98	0.95	0.97
u. Number of 5-bird daily limits.	4	2	6

In FY92, overall license sales increased 2%, with 628 sold for the year. Harvest questionnaire results for FY92 will be included in next year's (FY93) report.

Black Francolin were detected on 16 of 23 spring game bird surveys conducted in May 1992 (Table 2). Francolin were found on 10 of the 11 surveys south of Route 4. Although no francolin were detected on the Reserve Craft Beach survey in the previous year, four birds were counted in this year's survey. Francolin were found on 6 of the 11 routes in northern Guam, including Two Lovers Point.

The Umatac survey route had the highest station counts this year, with an average of 4.40 birds/station. The highest relative increase in birds was on Reserve Craft Beach road, with the average station count increasing 1.0 birds/station. Large decreases, some greater than 6.00 birds per count, may be due to observer effects rather than actual decreases in

numbers in these areas. The average number of birds detected per station increased on 6 survey routes and decreased on 10 between 1991 (DAWR 1991) and 1992. There was a statistically significant (Wilcoxon Signed-rank Test, $Z = -2.181$, $p < 0.05$) pattern of change in the data and the differences in survey results between this year and last year. Francolin populations remain well established and stable throughout southern Guam and continue to expand their range into shrub-grass habitats in central and northern Guam.

Table 2. Numbers of Black Francolin (BLFR) detected per count and average number of birds detected per station during spring game bird surveys at various locations on Guam in May 1992. Values in the trend column are the difference between average station counts between years.

Survey Location	No. Stations	No. Birds Observed	1992 Ave./ station	1991 Ave./ station	Trend in Average 92-91
Tarague	10	0	0.00	0.00	0.00
CWSA	10	0	0.00	0.00	0.00
NWF	10	0	0.00	0.00	0.00
NAVCAMS	10	3	0.30	0.10	0.20
Capitol Improvement Road	10	0	0.00	0.00	0.00
Mt. Santa Rosa	10	1	0.10	0.00	0.10
Y SengSong	10	0	0.00	0.00	0.00
Two Lovers Point	10	8	0.80	4.10	-3.30
Andy South	10	2	0.20	0.10	0.10
Navy Golf Course, Barrigada	10	24	2.40	4.90	-2.50
Barrigada Hill	10	9	0.90	4.67	-3.77
Toto Pipeline	10	0	0.00	0.10	-0.10
Nimitz Hill	10	19	1.90	10.80	-8.10
Reserve Craft Beach Road	4	4	1.00	0.00	1.00
Orote Point	6	2	0.33	3.00	-2.67
Pulantat	10	39	3.90	3.20	0.70
Cross Island Rd.	10	33	3.30	2.50	0.80
NAVMAG	10	38	3.80	3.70	0.10
Umatac	10	44	4.40	11.20	-6.80
Dandan	10	23	2.30	11.90	-9.60
Ija	10	40	4.00	4.70	-0.70
Merizo	10	21	2.10	8.44	-6.34
Cocos Island	10	0	0.00	0.00	0.00

RECOMMENDATIONS

1. Continue to monitor francolin population status, distribution, and hunter harvest.
2. Increase the response rate of annual hunter questionnaire.

LITERATURE CITED

Division of Aquatic and Wildlife Resources. 1991. Job Progress Report. Federal Aid to Fish and Wildlife Restoration. Div. Aquatic Wildl. Res., Dept. Agric., Mangilao.

Report prepared by Celestino F. Aguon

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: FW-2R-29
SUB-PROJECT NO.: W-3
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: The Status and Ecology of Wild Asiatic Water Buffalo on Guam.

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

The abundance of wild (feral) Asiatic water buffalo (*Bubalus bubalis*) on the U.S. Naval Magazine (NAVMAG) showed a non-significant increase during FY92.

BACKGROUND

Spotlight counts of Asiatic water buffalo, known locally as carabao, on NAVMAG were initiated in or about 1966 by the Division of Aquatic and Wildlife Resources (DAWR). The size of the base herd remained fairly constant from 1966-1978, averaging about 0.6-0.8 animals/km traveled during counts (Anderson 1980). Numbers began to increase in 1979 and peaked in 1982, with a mean of 2.6 animals/km (DAWR 1980-1982). Buffalo abundance declined thereafter, falling to a mean of about 1.5-1.7 animals/km during 1986-1988 (DAWR 1983-1988). In 1987, Biosystems Analysis Inc. (1989) estimated the population on the base to contain 75-150 animals. Counts increased to an average of 2.5 animals/km in 1989 (DAWR 1989), then declined to 1.4 animals/km by 1991 (DAWR 1991). Illegal hunting appears to be the major cause of mortality in the population (Conry 1988). High buffalo densities have resulted in localized habitat damage on NAVMAG (Conry 1988, Biosystems Analysis Inc. 1989).

OBJECTIVES

To monitor the status of the wild Asiatic water buffalo population on Guam and to determine if control measures are necessary to maintain the population at a level compatible with the available resources.

PROCEDURES

1. Conduct monthly spotlight counts on NAVMAG. Analyze count data and compare with past data to estimate population trends.

RESULTS

The average number of water buffalo seen per spotlight count on NAVMAG reflected a non-significant increase from 1.4 animals/km in FY91 to 1.7 animals/km in FY92 (Mann-Whitney *U*-Test, $U=36$, $P=0.10$) (Table 1). The mean number of animals seen per count in FY92 was 41.5 animals. The largest number of water buffalo recorded on a monthly count increased from 48 animals in FY91 to 70 animals in FY92. No additional work to

assess the population parameters of the NAVMAG herd was done during the year because limitations in manpower.

Table 1. Results of monthly spotlight counts of feral water buffalo at Naval Magazine, FY92.

Month	No. animals observed	Km traveled	Animals/ km	Miles traveled	Animals/ mile
Oct	48	25.6	1.9	16.0	3.0
Nov	33	24.3	1.4	15.2	2.2
Dec	44	24.0	1.8	15.0	2.9
Jan	24	24.0	1.0	15.0	2.2
Feb	39	22.4	1.7	14.0	2.8
Mar	52	24.0	2.2	15.0	3.5
Apr	24	22.8	1.1	14.3	1.7
May	30	19.7	1.5	12.3	2.4
Jun	61	25.9	2.4	16.2	3.7
Jul	70	23.5	3.0	14.7	4.8
Aug	no data				
Sep	32	27.0	1.2	16.9	1.9
Total	457	263.2	-	164.6	-
Ave	41.5	23.9	1.7	15.0	2.8
SD	15.05		0.61		0.91
CV (%)	36.2		34.8		32.1

RECOMMENDATIONS

Continue monthly spotlight counts of water buffalo at NAVMAG. Additional aerial and ground surveys should be made as conducted in FY 1989 (DAWR 1989). An investigation into the impacts of water buffalo on NAVMAG's vegetation should be initiated. The construction of an enclosure on the base would help to evaluate damage to plant communities caused by browsing and wallowing. Other study activities should be expanded to obtain more biological information on diet, population characteristics, movements and general distribution, and causes of mortality.

LITERATURE CITED

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- Biosystems Analysis, Inc. 1989. Natural resources survey for the U. S. Naval Magazine, Guam (NavMag). Naval Facilities Engineering Command, Pearl Harbor, Hawaii.
- Conry, P.J. 1988. Management of feral and exotic game species on Guam. Trans. West. Sec. Wildl. Soc. 24:26-30.
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Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUBPROJECT NO.: W-4

STUDY NO.: 1

JOB NO.: 1

JOB TITLE: Survey and Inventory of Non-Game Birds

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

For the first time, roadside counts recorded no native birds. Black Drongos (*Dicrurus macrocercus*) declined further while Philippine Turtle-Doves (*Streptopelia bitorquata*) increased slightly. Cave censuses of Island Swiftlets (*Aerodramus vanokorensis*) revealed a total population of about 450 birds at two caves. The annual Mariana Crow (*Corvus kubaryi*) survey on Guam estimated about 50 birds, which is a slight but non-significant increase over last year's results. About 20-25 Micronesian Starlings (*Aplonis opacus*) continue to inhabit Cocos Island. A program to control monitor lizards (*Varanus indicus*) on the island was started in February. Two major storms, Typhoon Yuri in November and Typhoon Omar in August, struck Guam during the year, causing considerable damage to forests on parts of the islands and some mortality of wildlife.

BACKGROUND

Since the early 1960s, census data has documented the decline in both range and numbers of Guam's native land birds. Roadside counts initiated in 1960 over four routes in southern, central and northern Guam by the Division of Aquatic and Wildlife Resources (DAWR) have provided an index to the decline (DAWR 1974-1991). From 1979-1981 population trends were monitored using variable circular-plot techniques (Reynolds et al. 1980) and station counts in central and northern Guam (DAWR 1980-1982). In 1981, an intensive forest bird survey was conducted by the U.S. Fish and Wildlife Service and the DAWR (Engbring and Ramsey 1984). Some of these transects used in 1981 were repeated from 1982-1988 by the DAWR (1982-1988). In 1987, surveys of Island Swiftlets were begun at the major remaining nest cave on Naval Magazine (NAVMAG). Predation by brown tree snakes (*Boiga irregularis*) is the major factor contributing to the decline of Guam's native bird populations (Conry 1988; Savidge 1986, 1987).

Current distributions of native land birds are as follows: Mariana Crow, restricted to northern Guam with the center of distribution being Northwest Field (NWF), Conventional Weapons Storage Area (CWSA), and adjacent cliffclines on Andersen Air Force Base (AAFB); Island Swiftlet, primarily eastern NAVMAG and the Talofofo River Valley; Common Moorhen, found in wetlands in central and southern Guam; Micronesian Starling, found on AAFB, Cocos Island, the southern coasts of Guam, and downtown Agana; and the Yellow Bittern (*Ixobrychus sinensis*), found throughout the island (DAWR 1988-1991).

OBJECTIVES

To continue status surveys and natural history studies as called for in the recovery plans for Guam's endangered native birds (Beck and Savidge 1990, U.S. Fish and Wildlife Service 1991a, 1991b).

PROCEDURES

1. Roadside counts were conducted at bi-weekly intervals on three routes (North, North-Central, and NWF: see previous annual reports for locations of routes) in northern Guam by DAWR Conservation Officers. These routes were driven at approximately 6-9 kph beginning at sunrise. Numbers and species of all birds seen or heard were recorded, irrespective of the distance from the observer.
2. Monthly counts of Island Swiftlets were conducted at Mahlac Cave on NAVMAG. Observers sat at both entrances of the cave for a period of 1.5-2 hours before dark and recorded the numbers of birds flying in and out. The total number of birds inhabiting the cave was determined by subtracting the number of departures from the number of arrivals and by adding the number of birds estimated to be in the cave at the start of the count. Prior to each count, observers entered the cave for 0.5-1 hour to look for evidence of nesting and reproductive activity. The presence of nestlings and their calls and the incidence of adult birds that appeared to be incubating eggs or brooding young was noted. In order to avoid disturbing nesting birds, nests were viewed from a slightly elevated position off to the side of the cave rather than by lifting a mirror up to look inside the nests. The cave floor was searched and cleaned each month of eggshell fragments and whole eggs that had fallen from nests overhead.
3. Recorded-call playback surveys for Mariana Crows were conducted in northern Guam. At each station, tape-recorded calls were played for 2.5 minutes. This was followed by a 2-minute silent period during which the observer listened for crows. The numbers, distance, and plumage condition of the crows observed were recorded.

RESULTS

Roadside counts continue to document the status of birds in the northern half of Guam. Tables 1, 2 and 3 present monthly count data for FY92. Table 4 summarizes the data for all three routes during the year. On the North count (Table 1), six species were counted, as compared to seven species during FY91.

Table 1. Average number of birds observed each month on the North roadside counts during FY92 and the average number of birds per 100 km.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ttl	No/ Cont
Yellow Bittern	17	0	0	0	0	0	0	1	0	0	0	0	18	0.7
Black Francolin	0	0	0	0	0	0	0	0	3	2	0	5	10	0.4
Lesser Golden Plover	0	51	72	58	28	78	22	0	0	0	0	35	344	13.7
Philippine Turtle-Dov	10	4	1	0	3	0	5	6	4	5	1	4	43	1.7
Black Drongo	12	6	1	3	0	8	2	3	4	5	2	3	49	2.0
Eurasian Tree Sparrow	61	1	5	30	10	32	1	9	12	4	4	1	170	6.8
Km	72.6	77.2	74.0	80.1	79.3	117.	78.9	83	76.8	78.1	79.0	76.3	972.7	
						3								
Miles	45.1	48	46	49.8	49.3	72.9	49	51.6	47.7	48.5	49.1	47.4	604.4	
Counts	2	2	2	2	2	3	2	2	2	2	2	2	25	

For the first time since the inception of these survey routes in 1960, native forest birds were not observed this year. The Mariana Crow, which was observed in FY91, was not recorded during roadside surveys in FY92. Black Francolins (*Francolinus francolinus*) were recorded for the third consecutive year on this route. Black Drongos further declined, dropping to 5.04 birds per 100 km, versus 7.29 birds per 100 km in FY91. Philippine Turtle-Doves increased slightly from 3.58 birds per 100 km to 4.42 birds per 100 km.

Seven species were observed on the North-Central route (Table 2). White Terns and Black Francolins were again observed on this route. Eurasian Tree Sparrows decreased by 64% over last year's counts.

Table 2. Average number of birds per 100 km observed each month on the North-Central roadside counts during FY92.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	No/ Count
Yellow Bittern	0	0	5	1	0	2	2	3	1	0	1	0	15	0.6
Black Francolin	0	1	0	4	4	1	6	18	1	0	4	2	41	1.7
Lesser Golden Plover	86	60	179	177	25	109	21	0	0	0	0	62	719	30.0
White Tern	30	0	0	0	0	4	0	0	0	0	0	0	34	1.4
Philippine Turtle-Dove	9	1	2	6	2	7	8	16	1	10	6	3	71	3.0
Black Drongo	7	3	4	6	1	3	3	3	3	1	1	3	38	1.6
Eurasian Tree Sparrow	16	9	6	10	0	9	0	7	8	5	11	21	102	4.3
Km	40.2	43.5	41.2	41.5	20.9	62.8	41.5	41.5	40.2	40.6	42.2	39.1	495.2	
Miles	25	27	25.6	25.8	13	39	25.8	25.8	25	25.2	26.2	24.3	307.7	
Counts	2	2	2	2	1	3	2	2	2	2	2	2	24	

On the NWF route, Mariana Crows declined by 49% over last year's surveys (Table 3).

Table 3. The number of birds observed each month on the Northwest Field roadside counts during FY92 and the number of birds per 100 km.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Total	No/ Count
Yellow Bittern	0	1	2	0	0	0	0	0	0	0	0	0	3	0.1
Lesser Golden Plover	78	70	113	0	132	143	20	0	0	0	0	0	632	27.5
Philippine Turtle-Dove	10	7	8	0	5	22	17	10	10	8	17	17	135	5.9
Black Drongo	15	7	7	2	8	28	12	14	10	12	11	11	126	5.5
Mariana Crow	0	2	0	0	0	0	0	0	0	0	1	1	6	0.3
Km	37.3	41.4	41	36	36	62.3	38.3	30.9	32.7	30.9	30.4	30.6	447.9	
Miles	23.2	25.7	25.5	22.4	22.4	38.7	23.8	19.2	20.3	19.2	18.9	19	278.3	
Counts	2	2	2	2	2	3	2	2	2	2	2	0	23	

The Yellow Bittern, Lesser Golden-Plover (*Pluvialis dominica*), and Philippine Turtle-Dove showed increases over FY91 (Table 4).

Native Doves

On May 21, a single White-throated Ground-Dove was heard in a forested area fronting the southern portion of Fena Lake. This is first record of a native dove in southern Guam in many years. A single Mariana Fruit-Dove was heard calling in NWF near the CWSA boundary on 31 August, several days after Typhoon Omar (see Appendix B). The bird

was possibly blown to Guam from Rota during the storm. Rota experienced wind gusts of up to 100 mph during Omar.

Table 4. Results of Northwest Field, North, and North-Central roadside counts showing the mean number of birds per 100 km of travel, the standard deviation (SD), and the coefficient of variation (CV).

Species	Northwest Field			North			North Central		
	No/100 Km	SD	CV	No/100 Km	SD	CV	No/100 Km	SD	CV
Yellow Bittern	0.67	0.44	65.64	1.85	3.01	162.50	3.03	0.97	32.01
Black Francolin	0.0	0.0	0.0	1.03	1.04	101.24	8.28	2.63	31.75
Lesser Golden Plover	141.11	28.22	20.0	35.37	14.45	40.86	145.2	37.08	25.54
White Tern							6.87	6.14	89.46
Philippine Turtle-Dove	30.14	3.74	12.42	4.42	2.37	53.66	14.34	2.96	20.62
Black Drongo	28.13	3.25	11.56	5.04	2.30	45.66	7.67	1.67	21.71
Mariana Crow	1.34	0.72	54.00	0.0	0.0	0.0	0.0	0.0	0.0
Eurasian Tree-Sparrow	0.0	0.0	0.0	17.5	10.86	62.13	20.60	4.65	22.56

Island Swiftlets

Limitations in manpower resulted in only four censuses of Island Swiftlets being made at Mahlac (Firebreak 4) Cave during FY92. Monthly counts produced population estimates of 375-400 birds (Table 5), which is consistent with numbers recorded in FY91 (DAWR 1991). Swiftlet numbers remained fairly constant throughout the year, even though much reproductive activity was seen during most visits. This suggests that mortality is high within the population. Low survival rates of newly fledged young may be responsible. Large-sized chicks were commonly observed in nests, indicating that the young are surviving until at least the age of fledging.

No counts were made immediately after Typhoon Yuri, which occurred in late November, to assess the effects of the storm. However, two counts conducted after the passage of Typhoon Omar in late August, suggest the storm may have produced a small decline in the cave's population. A count of 340 birds was obtained in September, but was judged as possibly inaccurate because of several disturbances to the birds that occurred during the count. A follow-up census in October was made under nearly ideal conditions and produced a total of 375, which is thought to be much more accurate. It indicates a small decline of about 25 birds took place between July and September, most probably around the time of Typhoon Omar. Although high winds blew small branches and leaves deep into the north entrance of the cave during the storm, the winds did not knock down any nests. Good numbers of nestlings were seen and heard after the typhoon, indicating they survived the winds. See Appendices A and B for more details of the storms.

Snake activity in and around the cave was up in FY92. Moderate to high numbers of snake tracks were noted on the surface of guano deposits on the floor of Mahlac Cave during each of four visits. On visits in June and July, several dropping-like bunches of swiftlet feathers were found on the floor below nests. The origin of these is not yet known, but they are suspected to be from snakes. Six shed snake skins were found at the cave (five outside, 1 inside). Four snakes were seen on rock faces outside the south entrance of the cave; three of these were captured. Their sizes were as follows: 1) SVL = 885 mm, wt = 81.1 gr; 2) SVL = 1090 mm, wt = 199 gr; and 3) SVL = 1170 mm. The stomachs of two animals were empty, while the third contained gecko remains.

Four visits to Fachi Cave were made in FY92, but only one census was conducted. On 4 October, the cave was closed off because of flooding at both entrances. It was not checked again until 2 April, when 82 birds were present (Table 5). Previous counts at the cave had each tallied about 50 birds (DAWR 1990-1991). The cave was again completely shut off by high water on 1 September. Its closure was undoubtedly caused by the 32 inches of rain that fell during the month of August. However, surprisingly, the cave was entirely open and being used by birds a few weeks later on 30 September.

Table 5. Results of censuses for Island Swiftlets at Mahlac and Fachi Caves on Naval Magazine during FY92. Evidence of reproductive activities of swiftlets is also presented.

Date	Net No. of Birds Entering Cave	No. of Birds Estimated in Cave at Start of Count	Total No. of Birds Counted	Reproductive Parameters				
				No. of Whole Eggs Found on Cave Floor	No. of Eggshell Fragments on Cave Floor	No. of Nestlings Heard	No. of Nestlings Seen	Incubation or Brooding Observed
<u>Mahlac Cave</u>								
19 March 1992	356	47	403	2*	34*	4-5	8-10	yes
30 April	344	35	379	6	32	3-4	8-10	yes
3 June	-	-	-	3	25	3-4	5	undetermined
25 June	362	38	400	3	29	3-4	10-12	undetermined
23 July	-	-	-	3	24	2	6	yes
30 September	309	33	342	1*	3*	3-4	6-7	undetermined
28 October	370	5	375	0	2	1-2	0	no
<u>Fachi Cave</u>								
2 April 1992	47	35	82	0*	+	3-4	0	undetermined

Key: *note that more than one month had occurred between visits; - = no data gathered; + = present but not counted

Mariana Crows

Census Results - Fourteen transects with a total of 211 stations were used to survey eight regions of northern Guam during July (Table 6). Transect locations are described in DAWR (1990, 1991). Crows were present on eight transects (or 51%), which is the same as last year's results. The total number of crows (57) recorded during playback surveys increased 39% over last year's total (41), but the difference was not significant (Mann Whitney U-Test, $U=105.5$, n_1 and $n_2=14$, $p > 0.05$). Surveys conducted in the CWSA recorded the most birds (14), which did not change from last year's numbers (DAWR 1991). The NWF transect recorded eight crows, one less than last year's count.

Transects 7, 8, 9, and 11 recorded six or more crows. Transect 8, which had no birds last year, had six this year. Transect 11, which had only two in 1991, had nine crows this year.

The results of the 1992 survey are encouraging because of the slight increase in crow numbers, which occurred despite the effects of Typhoon Yuri which hit the island on November 27-28 (see Appendix A). It appears that Guam's remaining crows are able to survive storms of this magnitude. The birds were able to renest after the typhoon and three birds were fledged later in the breeding season (see next section).

Snake-Proofing of Crow Nests - Electrical barriers were successfully used to protect four crow nests in FY92. One nest in NWF was abandoned soon after it was snake-proofed. However, this pair of birds subsequently renested in another tree (*Elaeocarpus joga*), which was also snake-proofed. The nest of this pair was protected for 58 days until two

nestlings were fledged. A third nest, also in an *Elaeocarpus* tree in NWF, was snake-proofed and remained protected for 53 days when a single young was fledged. The egg in a fourth protected nest failed to hatch. This site was protected for 24 days until it was determined that it had been abandoned by the adults. The three fledglings are the first known successfully reared young to be produced in the wild since 1987 (DAWR 1988, unpublished report).

Table 6. Summary of results from tape playback of recorded crow calls conducted during July 1992. Incidental number of crows represents the number of birds observed or detected while traveling between stations. Locations of transects appear in DAWR (1990-1991).

Transect No.	Number of Stations	Number of Crows Obs.	No. of Stations with Crows	No. of Crows Obs. Incident.
1	50	14	6	0
2	36	8	6	0
3	12	0	0	0
4	10	0	0	0
5	8	0	0	1
6	11	0	0	0
7	10	9	7	0
8	23	6	2	0
9	9	7	6	6
10	9	1	1	3
11	7	9	2	0
12	9	0	0	0
13	8	0	0	0
14	9	3	2	0
TOTALS	211	57	32	10

The design and testing of this barrier was presented as a paper at the U.S.-Japan Joint Congress on Snake Control for Human Health and Wildlife Conservation, which was held in Laguana, Okinawa, on September 27-29. The paper was entitled "Protecting the nests of the Mariana Crow (*Corvus kubaryi*) against predation" and will be published as part of the proceedings of the symposium.

Micronesian Starlings

A limited investigation of the starling population on Cocos Island was conducted after Typhoon Yuri. Observations made for several months after the storm suggest that only about 20-25 birds remained on the island. One weakened bird with droopy wings was noted about a week after the storm. The DAWR reinitiated a supplemental feeding program with coconuts and other fruits in December. Feeding was done 2-3 times per week throughout most of the rest of FY92. Water was also placed at each feeding station during the dry season and was frequently used by the starlings.

Seabirds and Reef-Herons at Cocos Island

The DAWR continued to assess the population status of bird species on Cocos Island during FY92. Two evening counts for seabirds were made on 12 December and 28 May. These followed the same procedures used in FY91 (DAWR 1991). Separate observers sat near the southern end of the island, with one watching the east shore and the other facing the west, counting all birds arriving at and departing from the island for 1.67 to 2 hours prior to darkness. Census results continue to prove that the island has high conservation value for seabirds. During the passage of Typhoon Yuri on 27-28 November, Cocos Island was devastated by high surf, which was perhaps the worst to hit the island this century. The impacts of this storm will undoubtedly affect the ecology of the island for many years to come. See Appendix A for more information on the typhoon.

Black Noddies - A count of 3,976 noddies was obtained in December (Table 7), but there may have been some redundancy in the birds counted by each observer. Thus, we estimated that 3,000-3,800 birds were actually present. This is the largest census of Black Noddies ever recorded on the island. Ironically, the high count result was obtained soon after Typhoon Yuri, when an estimated several hundred birds were killed (Appendix A).

Table 7. Results of evening counts by time period for Black Noddies and White Terns on Cocos Island in FY92.

Time Period	Net Number of Birds Arriving			
	12 December		28 May	
	Black Noddies	White Terns	Black Noddies	White Terns
Roosting at start	0	20	0	0
1700-1710	1	0	-	-
1710-1720	81	14	-	-
1720-1730	85	13	-	-
1730-1740	162	4	0	7
1740-1750	388	6	0	5
1750-1800	768	6	4	10
1800-1810	1,086	4	0	1
1810-1820	707	5	0	2
1820-1830	578	0	0	4
1830-1840	88	0	3	6
1840-1850	32	0	0	4
1850-1900	-	-	0	2
1900-1910	-	-	0	0
Total	3,976	72	7	41

On 21 April, the DAWR received an anonymous call from a fisherman who had camped overnight on the island and had witnessed a dump truck from the resort drive through the government property in the middle of the night. This had scared up many of the roosting noddies. Incidents of this type may have led to the abandonment of the island by the noddy colony. A count in late May showed that only a few noddies, probably less than 25 birds, remained on the island. However, by August, noddy numbers increased off the southwestern coast of Guam and indicated that at least several hundred birds were again present on Cocos.

White Terns - Relatively small numbers of about 40-70 White Terns were noted during the two evenings censused (Table 7). However, based on daytime sightings on the island and from offshore boats, the total population is believed to be much larger at about 150-200

birds. Typhoon-related mortality was judged to be low. No carcasses were found during our searches.

Pacific Reef-Herons (Egretta sacra) - Cocos Island is the only location on Guam where reef-herons are known to nest (DAWR 1991). In June and July 1992, six nests were present in the forested area just east of the abandoned Coast Guard station, with five located in the crowns of coconut trees and one in a *Casuarina* tree. Two of the nests each fledged a pair of chicks, however, chicks were never seen in the other nests. No decline in reef-heron numbers or activity was noted on Cocos Island after Typhoon Yuri.

Other Species - Two to three Sooty Terns (*Sterna fuscata*) were observed on Cocos Island on 12 December and feeding at offshore locations near Umatac and Agat on 11 May, and 7 and 15 June. Three Red-tailed Tropicbirds (*Phaethon rubricauda*) were seen over the island on 29 May. This is the first record of the species for Guam (Wiles et al., in prep.). A Streaked Shearwater (*Calonectris leucomelas*) was observed off Cocos Island on 11 May. Single Great Frigatebirds (*Fregata minor*) flew low near the island on the morning of 6 November and evening of 12 December. A variety of seabirds, including Brown Noddies (*Anous stolidus*), Black Noddies, White Terns, Sooty Terns, and Wedge-tailed Shearwaters (*Puffinus pacificus*), were observed feeding with skipjack tuna (*Katsuwonus pelamis*) on large schools of pelagic anchovies (*Enchrasicholina punctifer*) in June.

Monitor Lizard Removal Program - In February, the DAWR began a program to remove a small population of introduced monitor lizards from Cocos Island. Monitors pose a threat to nesting and roosting birds on the island, as well as to some of the rare lizard species present. Resort workers have previously reported watching a monitor lizard climb a coconut tree and capture a nestling Yellow Bittern.

Six funnel traps made of hardware cloth were placed on the island and checked 2-3 times per week for most of the rest of the year. Attempts were also made to remove animals by shooting them with pellet guns. A total of 11 monitor lizards were captured and taken off-island or killed. This included three animals captured in traps, two that were shot, and a small juvenile caught by hand. In addition, construction workers on the island caught and reportedly removed about five monitors. A number of small immatures were seen late in the year and proves that a breeding population has become established. Therefore, it is important that removal efforts be continued in FY93 so that complete eradication is attained.

Lovebirds at Tumon Bay

Two free-ranging populations of lovebirds (Peach-faced Lovebirds, *Agapornis roseicollis*, and Fischer's Lovebirds, *Agapornis fischeri*) were discovered in Tumon Bay during 1990 and 1991 (DAWR 1991). Subsequent observations made on 12 and 21 August 1992 found no birds (R. Beck, pers. obs.), and suggests that both groups of birds have disappeared for undetermined reasons.

RECOMMENDATIONS

1. Continue bi-monthly roadside counts over the three routes in northern Guam.
2. Continue to census the Mariana Crow in order to estimate population size and distribution on Guam.
3. Continue breeding biology studies and attempts to snake proof nest sites of the Mariana Crow on Guam.

4. Continue monthly cave censuses and efforts to assess population change and reproductive activity of Island Swiftlets.
5. Consider snake-proofing Mahlac Cave to protect nesting swiftlets.
6. Conduct further observations on the foraging behavior of swiftlets. Determine whether there is any seasonal variation in the foraging range of the colony. Interview farmers in the Talofoto River valley about the use of pesticides on their farms.
7. Develop and implement methods for control of the brown tree snake.
8. Continue efforts to captive breed endemic endangered native land birds on Guam and at stateside zoos.
9. Continue to monitor the population of Common Moorhens and develop an appropriate habitat improvement and development program.

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Report prepared by: Celestino F. Aguon and Gary J. Wiles

APPENDIX A

DAMAGE TO WILDLIFE AND OTHER NATURAL RESOURCES BY TYPHOON YURI

Guam received high winds and surf from Typhoon Yuri throughout the evening of 27-28 November 1991. The storm's closest point of approach occurred at 10:00 p.m. on 27 November, when the eye passed about 50 miles south of the island. Sustained wind speeds were estimated at 120 mph in Merizo, 90-100 mph in central Guam, and 60-70 mph at Andersen Air Force Base. Winds from the typhoon came predominantly out of the northeast, east, and southeast, and about 6-8 inches of rain fell during the storm. Damage to homes and other buildings was most severe in the southern villages of Inarajan and Merizo, but occurred to a lesser extent throughout the rest of the island. The worst damage resulted from high surf, which was possibly the worst to hit Guam this century. It struck predominantly in the southeastern corner of the island and destroyed homes and washed out sections of Route 4. High surf and winds also destroyed much of the rebuilding effort being done at the Cocos Island Resort. Staff of the Division of Aquatic and Wildlife Resources (DAWR) conducted damage assessments of the island's wildlife and terrestrial habitats from 29 November to mid-January. Typhoon Yuri occurred just 11 months after the passage of Typhoon Russ, another severe storm that struck southern Guam.

Habitat damage from Typhoon Yuri was greatest in southern Guam. However, in contrast to the damage of Typhoon Russ, blowdowns of trees and large broken limbs were rare, even in the southern part of the island. On most of the island, tree damage was largely limited to defoliation and small to medium-sized limb breakage. Most fallen trees were outside of forests in relatively open and unprotected locations such as in villages and along fields and roadsides. Tangantangan and *Hibiscus tiliaceus* suffered more damage than most other species of trees. Several tracts of forest in the south were examined from overlooks for damage. The Madog and Chagane River valleys in Umatac and the Talofoto River valley in Talofoto had much defoliation. Forests on the tall mountain ridgeline on western Naval Magazine suffered much defoliation, but contained few blowdowns of large trees. Damage was reduced in northern Guam, particularly along cliffs that were protected from easterly and southeasterly winds. Grasslands and *Phragmites* marshes in the south appeared heavily wind-blown at many sites.

Heavy surf destroyed strand vegetation and pushed over trees in coastal areas from Fadian Point to Merizo. Storm surge penetrated several hundred meters inland at some locations, including Pago Bay, Ylig Bay, Talofoto Bay, Inarajan Bay, and Agfayan Bay. Vegetation was severely damaged or washed away on the small offshore islets in southeastern Guam, with heavy surf appearing to be responsible for most of the losses. *Pemphis* vegetation was stripped of nearly all its foliage and smaller branches on Asgadao, Fofos, and Agrigan Islands. On Asgadao Island, the only prominent vegetation remaining after the storm was a battered stand of brown *Casuarina* in the center of the island. A small coral islet across from Jeff's Pirates Cove in Ipan lost virtually all of its *Pemphis* foliage.

Yuri's effects on Cocos Island will likely be felt for several decades. High surf washed over all of Cocos Island during the storm and in the process, deposited a vast amount of human-made debris in the island's native forest. The garbage was comprised of plywood, piping, chunks of concrete, various other construction material, and assorted junk from the resort which had been stockpiled on the windward shore during cleanup operations after Typhoon Russ. The material was never removed from the island as it should have been and will likely now remain where it lies. Accumulations of the junk were 1-1.5 m deep in places. Unless it is somehow removed, the debris could have profound effects on the

ecology of the strand forest. Its great coverage of the ground will prohibit seedling growth of native trees in some areas for at least several years. The material will likely be covered by dense vine growth, which will further discourage the re-establishment of trees. It could affect populations of various lizard species on the island, as well as the Micronesian Starling population.

Yuri probably had little overall effect on Guam's wildlife, especially in the northern half of the island. On Cocos Island, surveys indicate that only one flock of about 10 Eurasian Tree-Sparrows survived, and that the starling population was further reduced to about 20 birds. About 35 dead Black Noddies were found among debris in strand forest. It is estimated that several hundred of these birds were probably killed. Birds grounded by high winds were probably particularly vulnerable to the surf that washed over the island. Interestingly, a noddy count on 12 December revealed an estimated 3,000-3,800 birds roosting on the island, which is the highest total yet obtained during DAWR censuses. Three coconut crabs were also found dead during post-storm surveys, and resort workers reported that they saw many dead coconut crabs immediately after the typhoon.

Report prepared by: Gary J. Wiles

APPENDIX B

ASSESSMENT OF DAMAGE TO GUAM'S NATURAL RESOURCES FROM TYPHOON OMAR

Typhoon Omar passed over Guam on the afternoon of Friday, 28 August 1992. It was the most destructive storm to strike Guam since at least 1976 and perhaps dating back to 1962. Wind speeds were estimated at 120-130 mph sustained and gusting to 150-160 mph. Weather instruments at Andersen Air Force Base (AAFB) recorded sustained winds of 103 mph and gusts of 156 mph during the first half of the typhoon, but were lost during the second half. Sustained winds of more than 60 mph lasted about 16 hours. The eye of the storm passed over central and northern Guam, extending from Talofofo and Santa Rita in the south to AAFB in the north. Eye passage lasted about one hour in Barrigada and 20 minutes at AAFB. Winds were out of the northeast during the first half of the typhoon and from the southwest during the second half. Omar did not produce destructive surf conditions, however, it did drop large amounts of rainfall, approximately 12 inches at Naval Air Station and 16 inches at AAFB, during the three-day period from 27-29 August.

Omar caused severe damage to natural resources throughout the island. An initial assessment of the destruction was made by staff of the Division of Aquatic and Wildlife Resources (DAWR) on 31 August and 1-2 September. This was followed by additional field observations and surveys during the next two months.

Damage to forests appeared to be somewhat more severe in northern Guam, particularly along the northeastern coast from Anao Point to Tarague Basin. However, pockets of vegetation that had been severely damaged or largely unscathed were found throughout the island. The extent of damage was obviously dependent on the predominant wind directions, local topography, and the types of forest involved. As noted during Typhoons Russ and Yuri, tangantangan (*Leucaena leucocephala*), pago (*Hibiscus tiliaceus*), African tulip (*Spathodea campanulata*), and breadfruit (*Artocarpus* spp.) were among the tree species most susceptible to high winds. Nearly all stands of tangantangan on the island suffered severe defoliation and loss of some branches. Coconut palms (*Cocos nucifera*), betel nut palms (*Areca catechu*), and ironwood (*Casuarina equisetifolia*) were species that held up well in the high winds. Blown-over trees and broken trunks were more prevalent along the edges of openings (e.g., roads, yards, and various types of clearings) and in urban and suburban areas than in contiguous forest.

Specific areas of the island that were surveyed for damage are described below:

AAFB - Forests from Anao Point to Tarague Basin experienced the worst damage seen anywhere. At Pati Point, all forests on the cliffline, coastal flat, and plateau were nearly completely defoliated with much loss of small and medium-sized branches and limbs, and moderate loss of large limbs. Some large trees were blown down.

Forest damage in the Tarague Basin was similarly severe with many downed trees. Coconut trees in the large grove along the coast fared fairly well, but broadleaf species suffered extreme leaf loss, many broken limbs and trunks, and some blow downs. A thin layer of sand was deposited over the entire beach park and some of the tall exposed coconut trees there were downed.

At Ritidian Point, much stripping of foliage occurred on top of the plateau. Trees along the westward facing cliffline of the point suffered much less defoliation and appeared normally leaved out in some areas, yet in the vicinity of the coastal coconut grove on the former

Naval Facility base, broadleaf trees were severely stripped. A similar phenomenon was noticed from the main overlook above the Artero property, with almost no damage to trees growing along the cliffline yet heavy damage occurring to trees on the flat between the cliff and the ocean.

Defoliation in Northwest Field (NWF) and the Conventional Weapons Storage Area (CWSA) was severe, with a fair number of large and small trees blown down. The limestone forest on the plateau east of the AAFB golf course appeared to be in relatively good condition, considering its close proximity to Pati Point. Trees in the area were not as badly stripped as on Pati Point and there were fewer blow downs of large trees.

Northeast Coast of Guam - Forests along the Back Road to Andersen (Route 15), which are comprised largely of tangantangan and secondary limestone forest, were extensively defoliated, but the canopy appeared mostly intact in most areas. Heavy breakage of tree trunks and main limbs was observed near Andersen South. However, only minor damage was noted to the primary limestone forest growing nearby on the cliffline in Marbo Basin. Many of the trees there retained most of their leaves. Defoliation was much more severe on the floor of the basin and a few downed trees were seen. Swordgrass on the slopes of Mt. Santa Rosa appeared largely intact, but leaned at 45° angles in many areas.

Two Lovers Point - Heavy loss of foliage and a large amount of broken limbs and trunks were observed among the trees growing along the rim of the cliffline on both sides of the point. Coconut groves at Faifai Beach and Gun Beach appeared more heavily damaged than other stands of coconuts on the island. Although no trees were knocked down, all had lost many fronds and all of the remaining fronds drooped downward along the tree trunks. Amazingly, just 200-300 m north of the Faifai grove, a patch of limestone forest on a steep section of hillside was almost untouched, with virtually all foliage looking intact and unblown.

Tamuning, Agana, and Anigua Clifflines - Severe leaf loss and breakage of small to medium-sized limbs occurred on these cliffs. The loss of foliage allowed the walls of the cliffs to be seen in nearly all locations. Several small landslides occurred, and in Anigua, moderate numbers of palma brava (*Heterospatha elata*) trees were blown down. Similar damage was seen in small areas along the cliffline in Asan, but for the most part, damage looked slightly less severe in this area.

Naval Magazine - The amount of damage to forests here was highly variable, with some sections badly torn up and others much less so. Some small valleys in the eastern half of the base were heavily damaged, although some of these areas were predominated by damage-prone tangantangan and hibiscus. In contrast, lowland swamp forest near the Mahlac Stream suffered little damage. The upper forests on both sides of the Mt. Lamlam-Mt. Alifan ridge were heavily defoliated, with more broken limbs and downed trees occurring on the west slope.

Talofofo and Geus River Valleys - Vegetation in both valleys was badly defoliated, with trees experiencing considerable breakage of small branches. Most of the coconut trees in the Talofofo Valley appeared relatively intact.

Other Habitats - Savanna grasslands on Naval Magazine looked in fairly good condition. The *Phragmites* beds at the Atantano Marsh also weathered the typhoon well, with most reed stalks standing fairly erect or leaning somewhat. However, in the Agana Swamp, the *Phragmites* was torn up much more badly. The band of mangrove forest along Sasa Bay in Apra Harbor was only partially stripped of leaves and did not appear to suffer any loss of trees.

Cocos Island - Unlike in Typhoons Russ and Yuri, the Cocos Island suffered minor damage during Omar. Forest destruction was considerably less than anywhere else on Guam. Most damage appeared to result from wind and surf coming from the southwest during the second half of the storm. Almost no destruction from high surf was noted, with the *Pemphis* shrub zone along the eastern shore remaining mostly intact. A small part of the island, probably less than 2% of the total area, was flooded by seawater. This occurred at one site on the western shore of the island at the boundary line between the resort and government property. The water came 30-40 m ashore at this location.

All of the island's papayas, which had grown up after Yuri and reached heights of 1-1.5 m, had torn and withered leaves or had lost their leaves entirely. Many were leaning at 45° angles. Most were probably not killed and are expected to resprout, however, fruit production, which is important to the Micronesian Starling population, will probably be delayed 4-5 months. Coconut and *Casuarina* trees on the island suffered little damage from the storm, although a few large *Casuarina* limbs were broken off. The few large broadleaf trees on the island exhibited some foliage loss or damage, but much less so than on similar trees on Guam. Weedy and shrubby ground cover looked mostly intact and remained dense.

Recovery After the Typhoon - Typhoon Omar carried heavy rains and occurred during the first half of Guam's annual rainy season. Thus, considerable precipitation was available to assist in the recovery of vegetation soon after the storm. By 9 September, tangantangan, *Cynometra ramiflora*, and *Hibiscus tiliaceus* were already resprouting new leaves. On 14 September, many other species of plants had also begun growing new foliage, and leaf cover on tangantangan had become thick enough to reduce visibility in stands to pre-typhoon conditions.

In many limestone and ravine forests with large numbers of deer and feral pigs, recovery of certain plant species through natural recruitment will be slow or will not occur at all. Heavy browsing and rooting by ungulates will probably make it impossible to replace the losses of many large trees. For example, the destruction of mature seedy breadfruit (*Artocarpus mariannensis*) trees during Omar means that the population of this important wildlife food species is permanently reduced until deer and pigs are controlled enough to allow new trees to survive. *Eleaocarpus joga* is another species of concern.

Effects on Wildlife - Numbers of Mariana Crows appeared similar to those present before the storm. Two large former nest trees, both of which were *Eleaocarpus*, were destroyed, but most *Eleaocarpus* with potential for nesting appeared to have survived with moderate leaf loss and little limb breakage. We originally hypothesized that the defoliation of *Eleaocarpus* trees might delay the onset of the crow nesting season, which normally begins with initial nest construction in about November. It was thought that crows might wait until sufficient protective foliage had grown back in the crowns of these trees. However, as of mid-October, refoilation of forests had progressed quite far, with new leaf growth being quite dense in most areas. Sightings of a few crows carrying nest material were made at this time. Thus, the nesting season appears to be progressing as normal.

The fruit bat colony was present at the same location on Pati Point before and after the typhoon. A census of the colony was delayed for several weeks because of strong westerly winds, but was finally made on 18 September when 186 bats were seen. A second count on 18 October revealed 203 bats. Numbers at the colony were therefore reduced by about one-third from pre-storm levels (307 bats counted on 2 July). The severity of the storm in the northeast corner of the island suggests that some bats may have indeed been killed during the storm. Typhoon Omar was strong enough to blow down three fairly important trees in the roost. The decline in numbers could also result from bats

dispersing to other less damaged parts of the island to find food. However, evidence against this theory comes from observations of animals in the colony, which behaved normally and did not appear to be spending more time foraging than normal. A third explanation of the reduced numbers is that some bats had flown to Rota sometime during the two-month period between early July and the date of the typhoon.

One note of particular interest was that despite the loss of the three roost trees, most of the trees in the bat roost retained most of their leaves and showed little wind damage. However, defoliation was extremely severe just 50-75 m away on the plateaus above and below the roost. The roost is located in a small gently curving indentation in the cliffline and this apparently afforded some protection from the winds.

A single Mariana Fruit-Dove was heard calling in NWF near the CWSA boundary and was possibly blown down to Guam from Rota. Rota experienced wind gusts of up to 100 mph during Omar.

At Cocos Island, reasonable numbers of Black Noddies and White Terns were seen, suggesting that their populations were not badly harmed by Typhoon Omar. No dead noddies were seen in the island's forest during 45 minutes of searching for carcasses, however, an individual with an injured wing was found walking on the beach. It was unable to fly and was undoubtedly injured in the typhoon five days earlier. Starling numbers appeared similar to pre-typhoon levels (i.e., about 20 birds). Several immatures were seen in one group. Other species (Philippine Turtle-Doves, Pacific Reef-Herons, and Eurasian Tree-Sparrows) also survived well. A probable immature White Tern was seen in one tree top, suggesting that winds were not strong enough to blow it from its tree.

The effects of Typhoon Omar on other species are harder to judge. Two dead tree-sparrows were found in the yard of a home in Tamuning. One of these was an adult that was stripped of nearly all feathers. The impacts on Common Moorhens, deer, and feral pigs were not determined, but none seem particularly vulnerable to the long-term damage produced by the storm.

One of the two known adult *Serianthes nelsonii* trees on the island was killed during the typhoon. The tree, which was located in NWF, had its trunk snapped off about 3 m above ground level, where a termite colony had hollowed out the wood and weakened the tree. Eleven small seedlings still survive under this tree.

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JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: W-5

STUDY NO.: 1

JOB NO.: 2

JOB TITLE: Natural History, Biology, and Habitat Protection for Marianas Fruit Bats

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Guam's fruit bat population is currently estimated at 295-370 animals, which is a slight decline of about 80 bats from the previous year. Bat colonies used three roosts on Pati Point during the year, one of which was inhabited the entire year. No cases of illegal hunting were documented or suspected during the year. In FY92, 7,727 frozen fruit bats were imported to Guam from other islands for human consumption, an increase of 2.3% from the previous year. A draft report for the fruit bat survey conducted in Palau in 1991 was completed this year.

BACKGROUND

The Marianas fruit bat (*Pteropus mariannus mariannus*) has been under investigation by the Guam Division of Aquatic and Wildlife Resources (DAWR) since 1962 (DAWR 1964-1991). Considered a delicacy by Chamorro residents, bats steadily declined in numbers during the 1960s and 1970s until only a few solitary animals remained (Perez 1972, Wheeler and Aguon 1978, Wiles 1987a). Reasons for the decline included: increased human population pressures that resulted in overhunting and habitat loss, commercial exploitation of bats as a food, the lack of an adequate enforcement staff, and delays by the local legislature in passing protective legislation (Wheeler 1979). The Marianas fruit bat and the little Marianas fruit bat (*P. tokudae*) were placed on Guam's territorial Endangered Species List in 1981 and on the U.S. Endangered Species List in 1984, however *P. tokudae* was probably already extinct by then. The island's population of Marianas fruit bats grew substantially to an estimated 850-1,000 animals between 1980 and 1982, probably from immigration of bats from Rota (Wiles 1987a, Wiles and Glass 1990). However, numbers have declined since 1983 because of continued illegal hunting and suspected predation on bats by brown tree snakes (*Boiga irregularis*) (Wiles 1987a, 1987b). Guam's fruit bat population was estimated at 370-450 animals in FY91 (DAWR 1991).

OBJECTIVES

To continue status surveys and natural history studies and to provide for continued protection of habitat as recommended in the Marianas Fruit Bat Recovery Plan (Wiles 1990).

PROCEDURES

1. Survey fruit bat distribution and numbers in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as initiated in the late 1970s.
 - a. Conduct annual surveys of fruit bats along Guam's northern cliffline with periodic surveys made elsewhere on the island. The emphasis of surveys should be to search for solitary bats and additional bat colonies.
 - b. Conduct monthly censuses at known bat colonies on Guam.
 - c. Assist the CNMI Division of Fish and Wildlife with surveys of fruit bats on other islands as needed.
2. Record information on the behavior and reproduction of fruit bats in colonies.
3. Determine habitat use of fruit bats. Visit abandoned roost colonies and record information about terrain and the size and abundance of vegetation present.
4. Monitor fruit bat imports to Guam from other islands in Micronesia and the Pacific.
5. Investigate illegal hunting of fruit bats on Guam. Visit abandoned roosting sites of colonies to determine illegal hunting effort. Assist Conservation Officers with investigations of bat poaching.

RESULTS

Locations of Bat Colonies on Guam

Fruit bat colonies were recorded at three locations on Pati Point in FY92. Roost 1, a favored site in previous years (DAWR 1987-1991), was used by the main colony for the entire year (Tables 1 and 2). Roosts 20 and 17 were inhabited by smaller numbers of bats only for several weeks in October. The abandonment of Roost 20 occurred during a period of southwesterly winds. This site is poorly protected from winds from this direction. Typhoons and other unusual changes in wind direction have been associated with past movements between roosts on Pati Point (DAWR 1988-1991). An inspection of the empty roost revealed no evidence of poaching or human intrusion.

Table 1. Approximate dates of use of four roosts used by colonies of Marianas fruit bats on Guam in FY92.

<u>Roost number</u>	<u>Roost location</u>	<u>Approximate periods of use by bats</u>
1	North Pati Point	18 Sept 91-present
17	North Pati Point	18 Sept-6 Oct 91
20	East Pati Point	30 Aug-19 Oct 91

The passage of two major storms, Typhoon Yuri on 27-28 November and Typhoon Omar on 28 August, did not cause any movement of the colony away from Roost 1. However, three large roost trees were blown down during Typhoon Omar. Despite the strength of this storm (see Aguon and Wiles 1992) and the loss of the trees, most trees in the roost retained most of their leaves and showed little wind damage. However, defoliation was extremely severe just 50-75 m away on the plateaus above and below the roost. The roost

is located in a small gently curved indentation in the cliffline and this apparently afforded some protection from the winds.

Table 2. Counts of Marianas fruit bats at roosts on Andersen AFB, Guam in FY92.

Date	Roost Number									Total
	1	14	15	16	17	18	19	20	21	
27 Sept 1991	75	0	0	0	9	0	0	191	-	275
3 Oct	+	0	0	0	6	0	0	71	-	x
10 Oct	+	0	0	0	1	0	0	10	-	x
28 Oct	282	0	0	0	0	0	0	0	0	282
25 Nov	287	0	0	0	0	0	0	0	0	287
29 Nov	254	-	-	-	-	-	-	-	-	254
31 Dec	449	0	0	0	0	0	0	0	-	449
31 Jan 1992	522	-	-	-	-	-	-	-	-	522
23 Mar	555	0	0	0	-	0	0	0	-	555
22 April	334	0	0	0	0	0	0	0	0	334
26 May	220	-	-	-	-	-	-	-	-	220
2 July	307	-	-	-	-	-	-	-	-	307
23 July	+	0	0	0	-	0	0	0	0	x
31 Aug	+	0	0	0	-	0	0	0	0	x
18 Sept	186	0	0	1	3	0	0	0	0	190

+ = Bats present at roost but no count made; - = site was not checked for bats; x = no total count made.

In February, the Air Force detonated a series of loud bombs at 20-minute intervals for much of a day at the EOD range at Tarague Beach. The noise did not appear to disturb the colony at Roost 1 or cause any unusual behavior.

Surveys of Fruit Bats on Guam

During FY92, censuses of fruit bats at colonies on Pati Point produced total counts ranging from a high of 555 animals in March to a low of 190 animals in September (Table 2). Counts of about 250-290 bats were obtained during the first two months of the year, then suddenly increased by about 200 animals in December. Numbers eventually rose to 555 bats by March, then fell sharply in April to about 300 bats and stayed at this level until early July. The next census of the colony was not made until several weeks after Typhoon Omar on 18 September when 186 bats were seen. Numbers at the colony were therefore reduced by about one-third from pre-storm levels (307 bats counted on 2 July). The severity of the storm in the northeast corner of the island suggests that some bats may have indeed been killed during the storm. The decline in numbers could also result from bats dispersing to other less damaged parts of the island to find food. However, evidence against this theory comes from observations of animals in the colony, which behaved normally and did not appear to be spending more time foraging than normal. A third explanation of the reduced numbers is that some bats had flown to Rota sometime during the two-month period between early July and the date of the typhoon.

An estimate of Guam's population of fruit bats at the end of FY92 was determined using the September count of 190 bats at Roosts 1, 16, and 17 (Table 2). Because some individuals were probably hidden by thick foliage during that count, the total number of adults in the roosts was likely to be 10-20% higher than the actual number recorded. In addition, based on previous observations (DAWR 1985), approximately 65% of the adults in the colonies were harem females. An estimated 10% of these animals probably possessed unweaned young. These figures provide an estimate of 209-228 adults and 13-15 juveniles, or a total of 222-243 bats, on Pati Point in September 1992.

Incidental daytime sightings of single fruit bats or pairs of bats were made during the year at Northwest Field (2 sightings), the Conventional Weapons Storage Area on AAFB (2 sightings), Tarague Point (2 sightings), Fena Lake (2 sightings), Tarague Beach (1 sighting), Haputo Point (1 sighting), a forested area in the Chochogo area of Toto (1 sighting), and the Navy golf course in Barrigada (1 sighting). Nighttime sightings occurred at Tumon Bay (2 sightings), the Conventional Weapons Storage Area (1 sighting), Mt. Machanao near Ritidian Point (1 sighting), and the Sabana Maagas area of Mangilao (1 sighting). The number of sightings in urbanized central Guam was particularly noteworthy this year and indicates that bats can be found foraging rarely throughout the island. Several of the sightings are documented in further detail here because they are so unusual. In Mangilao, family members watched a fruit bat feed on the flowers of a kapok tree in their yard for 2-3 consecutive nights in December. In Tumon Bay, fishermen saw a bat fly over their boat just outside the reef margin at 2100 hr on 2 April. It was flying from Oka Point to Two Lovers Point. Two weeks later, at 2030 hr, Wiles observed a bat fly into a grove of coconut trees next to Happy Landing Road and about halfway up the Tumon hillside.

Excluding bats residing in the colony at Pati Point, an estimated 50-75 fruit bats are still believed to live solitarily or in small groups along the island's northern cliffline that extends from Bijia Point to Iates Point. An additional 25-50 animals probably inhabit Naval Magazine and other forested areas in southern Guam. Based on these figures, Guam's island-wide population of fruit bats at the end of FY92 was estimated to contain about 295-370 animals.

Surveys of Fruit Bats on Other Islands

The DAWR did not participate in bat surveys on Rota or other islands in FY92. A draft report for the Palau survey conducted in April and May 1991 was completed this year and is under review (Wiles and Engbring, in prep.). It contains information on natural history, abundance, and proposed management recommendations.

Natural History

Reproductive data and other observations on the natural history of fruit bats on Guam was not gathered during FY92 because of limitations in manpower.

Illegal Hunting

Poaching has long been a major cause of mortality of *P. mariannus* in the southern Mariana Islands (Wiles 1987a, Wiles et al. 1989, Stinson et al. 1992). No cases of illegal hunting were documented or suspected on Guam in FY92. Poaching is still rampant on Rota, with nearly monthly changes in colony roosting sites suspected to be a result of hunting (E.M. Taisacan, pers. comm.).

Fruit Bat Imports

A total of 31,142 fruit bats were requested for import during FY92 (Table 3), a decrease of 10.8% from the previous year (DAWR 1991). All requests were made for *P. m. pelewensis* from Palau. The number of import permits issued by the DAWR declined to 388 for the year, a drop of 6.7% from FY91. Approximately 15.7% of all import permits issued by the DAWR in FY92 had fruit bats listed as one of the items requested.

CITES restrictions continued to play a major role in the origins of fruit bats imported to Guam in FY92. An estimated 7,727 frozen fruit bats in 199 shipments were shipped to

Guam from other islands during the year, with nearly all bats coming from Palau (Table 4). These figures represent a 2.3% increase in the estimated number of imported bats and a 12.3% decrease in the total number of shipments received as compared to FY91 (DAWR 1991). The volume of imports from Palau remained about the same as during FY91.

Several commercial importers were responsible for bringing in more than half (59.6%) of all bats during the year. They include:

Importer	Shipper	No. of bats	No. of shipments
1) Roman Q. Salas and John Q. Salas	Errolflynn Kloulechad	2,333	19
2) Francisca Beches	Ringang Beches	839	6
3) Akira Ruloked	John Mengidab, others	716	9
4) Bruno Rdialul	same as importer	485	3
5) Chamorro Market	Micro Import/Export	236	3
TOTAL		4,609	40

During FY92, 477 fruit bats in 30 shipments were confiscated by the U.S. Fish and Wildlife Service and Guam Customs and Quarantine Division upon entry into Guam. These figures represented 6.2% of the total number of bats brought to the island and 15.1% of the shipments received during the year. Shipments were seized for a variety of violations including 1) the presence of bats killed with shotguns in shipments from Palau, which violated Palau firearms laws and the Lacey Act, 2) lack of import permits or certificates of origin, and 3) violation of CITES restrictions.

RECOMMENDATIONS

1. Survey bat numbers and distribution along Guam's entire northern cliffline once or twice annually. Searches for additional colonies may be productive because continued poaching at bat roosts on Rota can cause large numbers of bats to move to Guam (Wiles and Glass 1990).
2. Continue observations at Guam's bat colonies. Information on reproductive biology, behavior, and social organization will be used to supplement data already gathered.
3. Summarize data previously collected and write reports on the diet, reproduction, and amount of snake predation on fruit bats.
4. Conduct a study of the vegetation, terrain, and proximity to development of known roosting sites to determine what site characteristics are important in the selection of roosting sites by fruit bat colonies.
5. Known bat roosting and foraging areas should be patrolled regularly by Conservation Officers. Part of their effort should be aimed at maintaining a visible presence at Jinapsan and Pajon Points, where poaching has been a serious problem in previous years.
6. Form a cooperative bat research program with the CNMI to collect information on the locations and sizes of colonies, reproductive biology and behavior within colonies. Most of the work done under this program would be conducted on Rota where a moderately sized bat population is found but where logistics prevent the CNMI from doing extensive fieldwork. Emphasis of this project would be to identify colonies should they move between Guam and Rota.
7. Continue to monitor fruit bat imports entering Guam.

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Report prepared by: Gary J. Wiles

Table 3. Numbers of frozen fruit bats requested for import to Guam from Palau from October 1, 1991 to September 30, 1992.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
No. bats requested	5,228	3,070	3,218	1,839	2,997	2,878	3,654	907	2,700	2,229	1,656	765	31,142
No. permits issued	45	39	44	30	36	35	43	14	24	38	30	10	388

Table 4. Numbers of frozen fruit bats imported to Guam from October 1, 1991 to September 30, 1992.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total*	No. of Shipments Received*	No. of Bats Confiscated	No. of Shipments Confiscated ^c
Palau	1,976	1,337	732	281	301	433	365	188	624	599	398	199	7,433 ^a	190	183 ^a	21
Philippines			222 ^b										222	1	222	1
Chuuk						25							25	1	25	1
Pohnpei				1						21			22	2	22	2
Indonesia							19 ^c						19	1	19	1
Yap			1						2			2	5	3	5	3
Rota		1											1	1	1	1
TOTAL	1,976	1,338	955	282	301	458	365	207	626	599	419	201	7,727 ^a	199	477 ^a	30

*Totals include confiscated bats.

^aTotals do not include shipments of 104 bats in October, 37 bats in January, and 100 bats in February, all from Palau, that were refused entry and were returned to Palau.

^bNone of the bats in this shipment were positively identified, however, about 200 of the bats appeared to be a medium-sized species of *Pteropus*, while the remaining animals were larger and comprised of two species, probably *Pteropus vampyrus* and *Acerodon jubatus*.

^cThe bats in this shipment were tentatively identified as *P. vampyrus*.

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-29

SUB-PROJECT NO.: W-5

STUDY NO.: 1

JOB NO.: 4

JOB TITLE: Roost Site Characteristics of Marianas Fruit Bats.

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

No significant effort was expended on this job during this segment.

Report Prepared by: Gary J. Wiles

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-7

STUDY NO.: 4

JOB NO.: 1

JOB TITLE: Captive Breeding Endangered Native Birds

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

During FY92, the number of Guam Rails at the Division of Aquatic and Wildlife Resources (DAWR) facility increased from 81 to 95. The Guam facility is now at capacity. Several aviaries were destroyed by a typhoon that passed over Guam. Construction is now underway to replace these aviaries. The Guam Micronesian Kingfisher population in captivity at mainland U.S. zoos decreased from 61 in December 1991 to 55 in September 1992.

BACKGROUND

The Guam Native Forest Bird Captive Breeding Program began in 1983 as a cooperative effort between the DAWR, member zoos of the American Association of Zoological Parks and Aquariums (AAZPA) and the U.S. Fish and Wildlife Service (USFWS) (DAWR 1983, Derrickson 1986, Shelton 1986). Predation by the brown tree snake, *Boiga irregularis*, now believed to be the single most important factor in the recent drastic decline of Guam's native forest birds (Savidge 1986, 1987; Conry 1988), precipitated the need for a captive breeding program when, by 1982, at least five species of Guam endemic species or subspecies were nearing extinction in the wild. Unfortunately by 1984, attempts at captive breeding three of these species, the Bridled White-eye, *Zosterops c. conspicillata*, Rufous Fantail, *Rhipidura rufifrons uraniae*, and the Guam Flycatcher, *Miagra freycineti*, were abandoned due to their virtual disappearance from the wild (DAWR 1984).

The Guam Rail, *Rallus owstoni*, and Guam subspecies of the Micronesian Kingfisher, *Halcyon c. cinnamomina*, were successfully brought into captivity (DAWR 1983-6), with the capture of 19 and 31 founder birds respectively. Rails first bred at the DAWR's facility on Guam and at the Conservation and Research Center (CRC) of the National Zoological Park in 1984. Dr. Scott Derrickson, Curator of Birds, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Front Royal, Virginia continued as coordinator for AAZPA's Guam Rail program. By 1991, the captive Guam Rail population had increased to more than 150, with Guam holding 81 in captivity.

Kingfishers were first bred at three mainland U.S. zoos (Bronx Zoo, Philadelphia Zoo and CRC) in 1985. During FY '88 the first studbook for the Micronesian Kingfisher was published by the Philadelphia Zoo (Bahner 1989). The kingfisher has been designated as a Species Survival Program species by the AAZPA. Beth Bahner of the Philadelphia Zoo continues as AAZPA designated studbook keeper for the kingfisher.

OBJECTIVES

Implement and manage a captive breeding program for the Guam Rail and other endangered endemic birds by setting up facilities on Guam and at zoos on the mainland U.S. with the assistance of member zoos of the AAZPA. Produce enough Guam Rails to support an effort to establish them on Rota.

PROCEDURES

1. Develop plans for and construct at least six steel framed 12 stall holding aviaries to replace existing wooden aviaries that have deteriorated from weather and typhoons. Add additional holding aviaries as the need arises.
2. Develop plans and construct a building to support food preparation areas, incubator and brooding equipment usage and storage of supplies and equipment.
3. Continue the routine maintenance and operation of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and its member zoos.
4. Develop techniques for the successful release of captive-reared birds in the wild once the factors responsible for their decline have been controlled.
5. Continue to consult with recognized authorities regarding captive breeding methodology, facility designs, and captive population management techniques.
6. Consult and coordinate with USFWS, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.
7. Breed rails in sufficient numbers to support the continuing introduction of the Guam Rail to Rota, Commonwealth of the Northern Mariana Islands, begun in 1989.

RESULTS

The number of Guam Rails at the DAWR captive breeding facility increased from 81 to 95 between 1 October 1991 and 31 September 1992, an increase of 14 rails for the year.

Two significant typhoons passed over or near to Guam during FY92 (Yuri, 27 November 1991; Omar, 28 August, 1992.). Three wooden 12-stall holding aviaries at the DAWR breeding facility were destroyed and had to be rebuilt during the year. This meant that no new additional holding aviaries were constructed during the year. The capacity of the Guam facility therefore remains at 92. As a result, breeding attempts were limited during the year and there were no transfers of rails from U.S. zoos to Guam.

Dr. Velma Harper, a local Guam veterinarian, successfully sexed 15 Guam Rails using a fiber optic laparoscope. In addition, Dr. Steve Nusbaum, the new Territorial Veterinarian, provided additional veterinary services for the program.

Seven rails died during the year, one from trauma, one from a cloacal egg impaction, and the rest from undetermined causes. Three of these undetermined deaths were probably related to the stress caused by Typhoon Omar; most were too emaciated to necropsy when found. One rail escaped from an aviary during routine feeding and was never recaptured.

Micronesian Kingfishers continue to be captive-bred at 18 mainland U.S. zoos (Bahner 1992a). The number of kingfishers in captivity declined from 61 in December 1991 (Bahner 1992a) to 55 in September 1992 (Bahner 1992b) (See Figure 1). A complete report of the status of the captive kingfisher population can be found in Bahner (1991a, b).

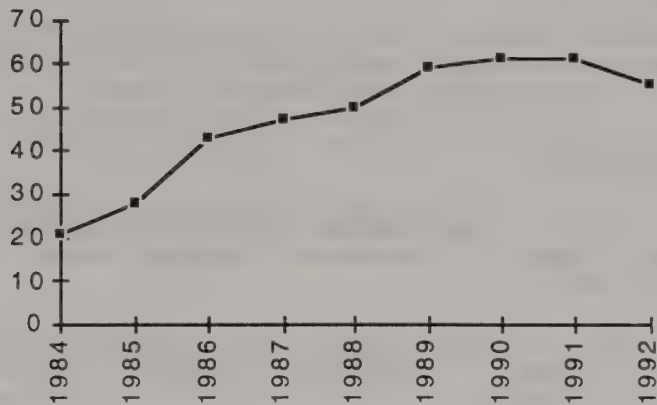


Figure 1. The number of Micronesian Kingfishers at U.S. zoos from 1984-1992 (Drawn from Bahner 1992 a,b).

RECOMMENDATIONS

1. Hire an aviculturist/wildlife biologist to supervise captive breeding of Guam Rails at DAWR facility and the release and monitoring of rails on Rota and other locations as selected.
2. Continue the routine maintenance and operation of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and its member zoos.
3. Construct at least four 12-stall wooden holding aviaries to replace existing wooden aviaries that were destroyed by typhoons. Add additional holding aviaries as the need arises. Develop plans for moving rail facility to a new site at Department of Agriculture compound.
4. Develop plans and funding for the construction of a building to support food preparation areas, incubator and brooding equipment usage, and storage of supplies and equipment at new site.
5. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.
6. Assist in the design of appropriate veterinary facilities at the proposed new Department of Agriculture building in order to upgrade support for the Division's captive breeding program.
7. Consult and coordinate with USFWS, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive

maintenance of wildlife. Acquire all necessary local and federal permits for shipment of rails between Guam and U.S. zoos.

8. Breed rails in sufficient numbers to support the continuing introduction of the Guam Rail to Rota, Commonwealth of the Northern Mariana Islands, begun in December 1989.
9. Coordinate with Dr. Derrickson of the CRC on the conversion of the DAWR's Guam Rail records to the system used by member zoos of AAZPA. This will facilitate better coordination of record keeping between Guam and U.S. zoos.

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Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-7

STUDY NO.: 4

JOB NO.: 2

JOB TITLE: Development of an Experimental Population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Due to a lack of staff, this project was inactive during FY92

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni*, and other native birds (DAWR 1961-1987; Jenkins 1983; Engbring and Ramsey 1984). Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Savidge 1986, 1987; Conry 1988). Research efforts are presently underway to develop methods for controlling rail predation by the brown tree snake.

A captive breeding program for the Guam Rail was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (AAZPA) (DAWR 1984-1987; Derrickson 1986). Guam Rails were first brought into captivity in 1983 on Guam and bred at the DAWR's rail facility in the spring of 1984 (DAWR 1983-4).

The DAWR developed plans to introduce the Guam Rail to Rota in order to develop a self sustaining wild population of rails that will not undergo "domestication" from captive breeding. It is hoped that the experience gained in introducing the rails to Rota will provide valuable information useful for future introductions on Guam. The Rota population may also serve as a partial source of birds for use in reintroducing the rail to Guam when snake predation has been controlled there.

During FY87, a cooperative agreement was signed between the Government of Guam, Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Fish and Wildlife Service (USFWS) outlining the responsibilities of each entity for the introduction. An environmental assessment was prepared for the USFWS covering the introduction of the Guam Rail to Rota. The DAWR reached an informal agreement with Dr. Stuart Pimm, Professor of Zoology, University of Tennessee, by which a graduate student, Greg Witteman, from the university will reside on Rota to monitor the initial two rail introductions in cooperation with the DAWR as a part of his dissertation research. Dr. Pimm was successful in obtaining several grants from international conservation

organizations to support the monitoring study on Rota. Using these funds, a half-ton pickup truck was purchased on Rota for use by the monitoring staff.

After the permit to establish an "experimental population" of Guam Rails from captive bred population was published by the USFWS in the *Federal Register* (USFWS 1989), 22 Guam rails were released at the first site on the Sabana on Rota during three releases in December 1989 and January 1990. All but one rail were released with radio transmitters to monitor their dispersal, mortality, and possible breeding success. Of the 22 released birds, the whereabouts of 9 are unknown as their radios failed, 4 were killed by vehicles, 2 were killed by cats, 2 apparently died of starvation, 1 died of poisoning, and 4 died of unknown causes (DAWR 1991, Witteman et. al. 1991).

I Chiugai was chosen as the site for the second rail release on Rota. On February 4, 1991, 31 rails were released there (Witteman and Beck 1991). This release appeared to be more successful than the 1990 release at the Sabana.

PROCEDURES

1. Continue to captive breed Guam Rails for use in the Rota introduction both on Guam and at mainland U.S. zoos.
2. Continue to develop techniques and methods for introduction of rails to Rota.
3. Implement disease prevention protocol with rails on Guam prior to release on Rota.
4. Continue the introduction of rails to Rota.
5. Monitor the release of rails on Rota.
6. Continue to seek funding from conservation organizations to support the monitoring of introduced rail populations.

RESULTS

Due to a lack of staff, this project was inactive during FY92. However, planning for a third release of rails continued.

RECOMMENDATIONS

1. Hire an aviculturist/wildlife biologist to supervise the captive breeding of Guam Rails at the DAWR facility and the release and monitoring of rails on Rota and other locations as selected.
2. Continue to captive breed Guam Rails needed for the Rota introduction, both on Guam and at mainland U.S. zoos.
3. Coordinate with Commonwealth of the Northern Marianas Division of Fish and Wildlife for the third release and monitoring of rails on Rota.
4. Implement disease prevention protocol with rails on Guam prior to release on Rota.
5. Initiate a larger third release of rails at I Chiugai, Rota with up to 50 rails from the DAWR's breeding facility and U.S. zoos. Conduct a follow-up release within one month, and continue additional releases at monthly intervals thereafter, with rails from

the same breeding facilities. This release pattern should continue until monitoring indicates that a wild bred rail population is established on Rota.

6. Begin planning for release and re-establishment of rails on Guam at "Area 50" on Northwest Field, Andersen Air Force Base, as soon as the site has been snake-proofed.

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Report prepared by: Robert E. Beck, Jr.

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO: E-1-7

STUDY NO: 7

JOB NO: 1

JOB TITLE: Biology of the Brown Tree Snake

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

This project was inactive during FY92 due to lack of staff.

Report Prepared By: Robert E. Beck, Jr.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-7

STUDY NO.: 7

JOB NO.: 3

JOB TITLE: Development and Testing of Control Methods for the Brown Tree Snake

PERIOD COVERED: October 1, 1991 to September 30, 1992

SUMMARY

Field tests of electrical barriers continued this fiscal year. Three Mariana Crows, *Corvus kubaryi* nests were successfully protected. Two nests fledged a total of three young and the third had an infertile egg. Results of the field use of electrical barriers were presented at a conference in Okinawa.

BACKGROUND

Roadside counts by the Guam Division of Aquatic and Wildlife Resources (DAWR) have documented the decline of the native forest birds of Guam (DAWR 1974-1991). Studies by Conry (1988) and Savidge (1986, 1987) have indicated that predation by brown tree snakes, *Boiga irregularis*, is the main cause of this decline.

Since these studies, attempts to develop adequate and effective means of protecting active nests of Mariana Crows, *Corvus kubaryi*, have been made. Clearing of vegetation in direct contact with the nest tree, snake trapping, use of galvanized sheet metal girdles, and use of Tangle-Foot have all been tried. The use of sheet metal girdles and Tangle-Foot resulted in the mortality of trees and was discontinued. Clearing of vegetation and snake trapping has met with some success. A combination of several methods may prove to be the most effective means of controlling snakes and other predators.

OBJECTIVES

To develop methods in controlling snake predation on active nests of native birds.

PROCEDURES

1. Conduct field tests on the use of electrical barriers for protecting crow nests.
2. Laboratory tests of alternative means of controlling brown tree snakes were conducted.

RESULTS

Field tests of electrical barriers were continued in the field this year. Three Mariana Crow nests were successfully protected during the 1991-92 breeding season. Two nests fledged a total of three young and a third nest had an infertile egg. More detail is provided in the native bird report.

The design of this barrier and results of its field use were presented in a paper at the U.S.-Japan Joint Congress on Snake Control for Human Health and Wildlife Conservation, which was held on September 27-29, 1992, at Laguana, Okinawa. The paper was entitled "Protecting the nests of the Mariana Crow (*Corvus kubaryi*) against predation".

RECOMMENDATIONS

1. Continue laboratory tests of possible means of protecting active native bird nests.
2. Conduct on-site tests of methods which prove effective in laboratory experiments on actual active nest trees.

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Report prepared by: Celestino F. Aguon

